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The Coloration of Mammals and Birds.

By J. LEWIS BONHOTE, M.A., F.L.S., F.Z.S., M.B.O.U., etc.

(*Continued from page* 317.)

Let us now consider for a moment the question of those mammals whose pelage changes at certain seasons of the year.

Roughly speaking, in the tropics, the wet and dry seasons correspond to our summer and winter, so that, if an animal is to be at all affected by the climate, the affection will show itself, roughly speaking, in spring and autumn, at the same time, approximately, as when the cold or heat are affecting the animals of more northern climes.

Mr. Lydekker, in an article in the *Field*,* points out that *Sciurus caniceps* was the only tropical mammal that, to his knowledge, had a seasonal change. This particular squirrel, in company with another, *S. atrodorsalis*, assumes in mid-winter a very bright or intense coloration on the back, which, as I have pointed out† some years ago, is caused by the advent of sexual activity, and not by any climatic or seasonal change. The climate at that time of year (December to February) is very constant, and this is, therefore, a clear instance of a change being brought about solely by sexual activity.

On the other hand, we have certain species, such as *Sciurus maclellandi*, *Funambulus berdmorei*, etc., in which their season of most intense colouring coincides with the summer or wet period, but in this case the change is merely one of relative brightness and not so marked as in the other cases.

Among birds, the changes seem to be almost always "breeding changes" for they take place at the breeding season and are probably due almost entirely to sexual causes and impulses, and we would suggest that any changes in the tropics which may take place, as being purely due to *seasonal* causes, are to be found among the representatives of northern races where the necessity of a change arose and has not yet been eradicated. A good example is to be found in *Mustela flavigula*. This animal, which is of a light brown and yellowish colour in Siberia, has in Nepal a marked seasonal change, becoming much darker in summer. In the Malay Peninsula, although both pelages are darker than those assumed in the North, the seasonal change still persists, while in Java and Sumatra, the dark brown form is permanent throughout the year. In the Peninsula of India is also found another species (*M. gwatkinsi*), which is uniformly dark, and has, as far as we know, no seasonal change.

* *Field*, 1903, p. 675. † *P.Z.S.*, 1901, p. 52.

To sum up concisely :—

Conditions of climate being more equable, "changes of pelage" are not so frequent in the tropics as in more northern climes ; when they do occur, they are probably due—

(1.) Either to the sexual impulses alone, *e.g.*, *S. caniceps* and *S. atrodorsalis*.

(2.) Or to a long ingrained habit,* owing to the animal having originally come from some climate where seasonal change was necessary, *e.g.*, *Mustela flavigula*, *Cervus*† and possibly *Sciurus*.

TEMPERATE REGIONS.

After all that has been said on the other regions, there is not much to note here, except to point out that the arguments for the other regions still hold good.

In the first place it is fairly self-evident that in most of the mammals and birds of this region the prevailing coloration is brown; white mammals are as scarce as they are in the tropics, and bright coloured forms belong, without exception, to tropical or cosmopolitan families. The squirrel and the fox are good instances of mammals that have partially retained their bright colour, the former during summer only, the latter throughout the year; the deer also are red in summer.

The birds also call for little comment on these lines. The bright species, as the kingfisher and roller, being typical of the tropics, and the Sylviidæ, or warblers, typically birds of the temperate region, are brown.

The chief interest of the temperate region, however, lies in those families that, stretching from the north and even penetrating the Arctic circle, may also be found on the northern edge of the tropics, becoming brighter and brighter gradually and throughout the whole distance as they approach the southern limit of their range.

More heat, better and more abundant food, more time between the periodic breeding season and the cold of winter, or the gentle advent of spring, all these are causes which, as we have shown, may and do affect the "vigour" of the individual, and it is by means of that "vigour" and not by their direct action that we suggest the brighter colours are produced.

* It is not advisable to press matters too minutely in a general paper, but it is perhaps worthy of note that in *Corvus eldi*, an inhabitant of Burma, Malay Peninsula and Cochin China, the brightest pelage is that assumed and worn in winter, and is therefore hardly analogous to the changes in *C. dewanceli*, whose brightest phase is in summer. I would therefore suggest that the change in *C. eldi* is purely a breeding change and that it has progressed a stage further than *C. axis and C. unicolor*, that have a similar pelage throughout the year, in having first eliminated the seasonal change and then adopted the breeding change; this would merely depend on the balance between the sexual and climatic impulses.

† For a further instance of the seasonal change persisting under altered conditions, see Captain Barrett-Hamilton. *P.Z.S.*, 1899—p. 598.

(*To be continued.*)

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The Evolution of the Flower.

By S. LEONARD BASTIN.

(*Continued from page* 324.)

PART II.

THE conspicuous and often attractively coloured sepals and petals of the flower, whilst serving their special purpose, are, after all, of but small importance when compared with the organs which fill up the centre of the typical blossom. These, as is well known, are divided into two distinct kinds—the stamens and the carpels—the latter collectively forming the pistil. The former organs produce the pollen grains which, coming into contact with the latter, fertilise the ovules and thus bring about the production of living seed. As a rule the stamens are in the form of small processes having slender stalks surmounted by heads or anthers; it is on the anthers that pollen is produced. The pistil, as has been stated, is composed of a number of carpels, and these are sometimes very distinct, or, on the other hand, they may be all joined together. Each carpel terminates in a longish pillar called a style, at the summit of which is the stigma, a moist, fleshy surface to which the grains of pollen readily adhere. At the base of the carpel is to be found the ovule, that highly specialised organ which is the forerunner of the seed.

At first sight it is not an easy matter to determine what may be the origin of the highly complicated male and female organs of the plant. Both the sepals and the petals of a flower exhibit more or less resemblance to the foliage of the plant, but there is certainly not much obvious connection between stamens and pistil and the leaf. Nevertheless, after the consideration of the instances which it has been the purpose of the present paper to bring together, it will be easy to credit the statement that the leaf was the ancestor of even the reproductive organs themselves.

In the Begonia, the near relation between stamens and petals is clearly observable.

In the case of the so-called "double" flowers it will be readily seen that a very large number of extra petals have entered into the composition of the blossom. These additional petals must have had their origin in something, and, as a matter of fact, they are degenerate stamens. The manner in which this transformation of stamens into petals is carried on is readily seen in the

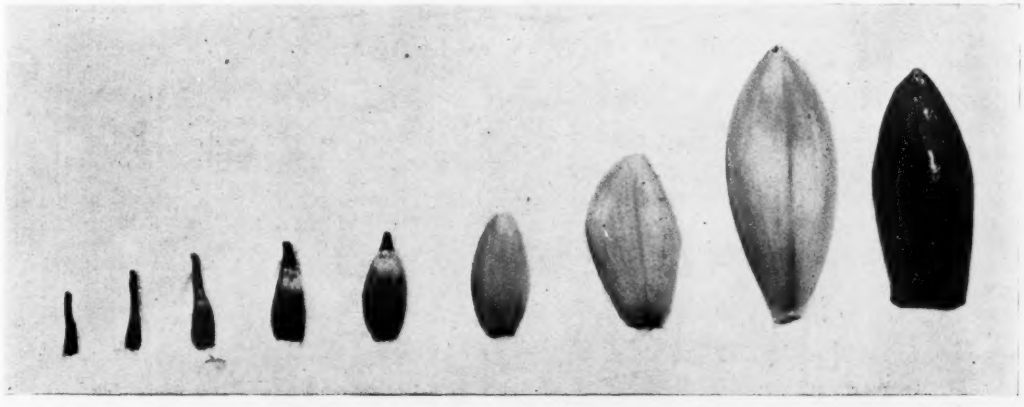
case of the Begonia. The florist has hitherto been completely vanquished in his attempts to produce a variety of Begonia which shall throw nothing but double flowers on each spray—a single flower always putting in an appearance. Occasionally a blossom is to be found in a curious midway state between the single and double condition, and when this is the case an interesting side light as to the connection between stamens and petals is to be seen. It is possible to trace the gradual degeneration of the stamens into the petals; some of these eccentric organs are just simply flattened stamens, resembling miniature petals except for the fact that they are covered with a deposit of pollen. Others have got away from the pollen altogether, have developed the coloured tissue, and are perfect petals in their way except that they are very small.

Probably one of the most marvellous object lessons in the whole of the plant world bearing on the origin of the stamens is to be seen in the case of the flowers of the Water Lily (*Nymphæa alba*). By a careful dissection of the flower of this plant a most instructive

Carpel of a single Cherry bloom (left) compared with leaf-like carpel of double Cherry flower.

bring forward further proof in support of the assertion that there is a very intimate connection between the stamens and the petals of the flower. As has been clearly shown on a previous occasion, the petals of the bloom have been obviously developed from the stamens, and these latter bring us back to the all-important leaf.

To trace in a clear fashion the leaf origin of the pistil is not quite such a simple matter as it was in the case



The near relations between the stamens and petals of the Water Lily flower are very evident.

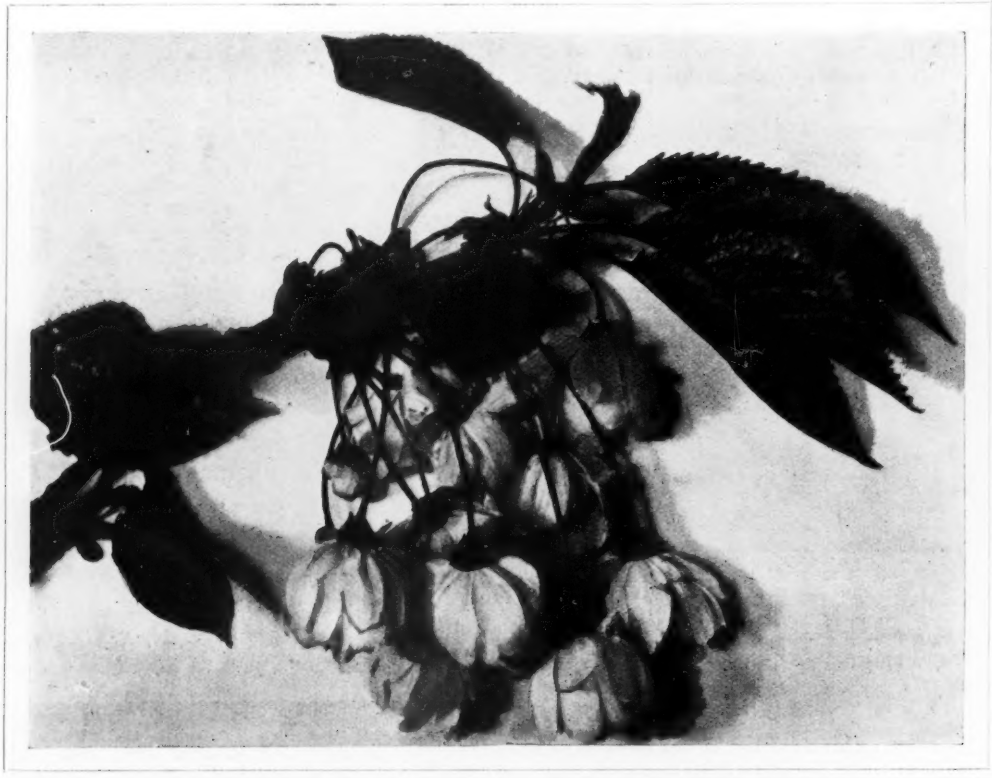
series of organs may be compiled, in which all the stages between the stamens and petals may be discerned. Starting away from the outside of the flower with the green sepal, it is interesting to note that this is partially coloured white, offering yet another proof of the origin of the petal. Passing over several rows of perfectly formed petals, it is noticeable that these are steadily decreasing in size the nearer one gets to the centre. Gradually these petals become modified in form until they are quite narrow, and at last one is seen to be curiously thickened at the point. This point is yellow in colour, and a microscopic examination of the substance reveals the fact that it is pollen. The termination of this organ, which one can call neither stamen nor petal, as one advances inwards, continues to be more and more modified until it resolves itself into two thickened parts; eventually these meet together and form the two lobes of the anther. Moreover, at this stage the petal-like process disappears altogether, narrowing down until it forms the filament of the stamen. In the inside rows of the stamens it is not possible to discern any resemblance between the petal and the male reproductive organs.

A similar process to that which is so striking in the case of the Water Lily flower is to be seen in the blossom of the Pæony, and, as well, other instances might be noticed. But it will scarcely be necessary to of the other three organs of the bloom which have already been dealt with. As is well known, the pistil is

A Double Cherry bloom with the centre petals removed, exposing the small leaf in the centre.

composed of one or a number of carpels, and these last bear at the base the wonderful ovules. A small amount

of investigation, however, will prove that these complicated and highly specialised organs have a leaf ancestry just as much as any other part of the flower. In a general way, although the stamens of the flower are, in the case of double blossoms, sacrificed to make up the additional petals, the pistil is in a more or less perfect condition. But there is just one double flower which lets a good deal of light on to the question of the origin of the pistil. This is the double Cherry, a flower which it will well repay anyone who is interested in the matter to study a little closely. If the inner petals of a well developed bloom of the double Cherry are torn away it will be found that almost invariably a tiny leaflet occupies the centre of the bloom. This little leaf, it will be noticed, is exactly in the place of the solitary carpel, which is, of course, the distinctive feature of the tribe. A comparison of this leaf with a perfect carpel of the Cherry is interesting. It is easy to see that the two sides of the small leaf represent the ovary, whilst the elongated process can be none other than the style.



In the centre of each Double Cherry bloom is to be found a small green leaf.

Later on in their history the carpels often develop into very leaf-like organs. This is the case in the seed vessel of the Pea, where it is discernible that the two sides of the pod are not unlike the lobes of a leaf joined together by a midrib. A rare and most suggestive monstrosity is sometimes to be seen in the case of the Pea pod. This comes about when the ovules fail to develop and the two sides of the pod do not close together in the normal fashion. On such occasions the lobes of the pod are more than ever leaf-like, not only in appearance, but actually in structure. It is possible to see small projections on the borders of this curiosity (which may be called the carpellary leaf) that show where, under ordinary conditions, the ovules would have been.

In the present and the preceding article all the different parts of the typical flower have been detailed in the order in which they occur when a start is made from the outside and one proceeds inwards. This method has been carried out as the simplest way of dealing with a rather difficult subject. To the reader who has followed the argument from the commencement the connection which each part of the flower has with the other is very apparent. In every instance one is brought back either directly, or through some other organ, to the leaf as the origin of the whole flower. That the leaf was in existence prior to the blossom is, of course, an indisputable fact, for whilst flowering plants can persist without blooms, they could not live at all without foliage or its equivalent.

Concerning the very important question as to the order in which the various parts of the flower were evolved there has been a good deal of controversy. A moment's consideration will be sufficient to show that the first part of the flower to be formed could scarcely have been the calyx, the next the corolla, and so on. It is almost impossible to conceive that these particular organs, which, after all, are only appendages, even though they serve a useful purpose, should have been formed in advance of the essential organs. The main object of the brightly-coloured corolla seems in every case to be as a means of advertising the presence of the stamens and pistil to the special agent which will under-

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take the process of fertilisation. Flowers with petals, but lacking the organs of reproduction, are, of course, unknown in Nature, whilst there are many instances where the stamens and pistil are in evidence, but in which the corolla is quite absent. So that the well-nigh inevitable conclusion is that the stamens and the pistil were developed from the leaf first of all, the corolla and its envelope, the calyx, later on. Thus we must regard the strange midway organs which have been noticed in the case of the flower of the Water Lily rather as degenerate stamens than as advancing petals.

The subject is such a profound one that it is not possible to do more than to hint at the wonderful process whereby the different parts of the flower as we see it to-day have been developed. One cannot help

A rare monstrosity of the Common Pea, where the lobes of the pod have failed to close together.

being impressed with the manner in which at every point one is brought face to face with the immense importance of the leaf in the economy of the plant. In the leaf is situated that basis of the plant life—protoplasm, present in the specialised form of chlorophyll. It is from the base of the leaf stalk in the majority of cases that every extension of the plant arises. Very many plants can, under certain conditions, give rise to fresh plants by means of their leaves, whilst some of the lowlier forms of green vegetable life never increase in any other way than by a process of leaf cell extension. Under these circumstances it will be admitted that we shall not be far wrong in regarding the leaf as the most important organ of the plant.

Our Own General Election.

THE results of our call for opinions has not developed any such remarkable surprises as those in the political world.

Though our thanks are due to many hundreds of readers who have kindly returned the Ballot Cards duly filled in, we are slightly disappointed that a larger proportion of our electorate did not record their votes. It may be due to laxity in the canvassing; but, perhaps, the fact is not of importance, since it must be presumed, as in the political elections, that those who did not poll are contented to leave the conduct of affairs in the hands of those in authority, without any very special wishes as to future policy.

The cards must be carefully gone through before we can definitely decide on any change of policy; but a cursory glance at them seems to show that most readers are quite satisfied with the arrangements now in vogue.

The Interior of the Earth.

Radioactivity and Volcanicity.

IN an article on "The Interior of the Earth," which appeared in "KNOWLEDGE AND SCIENTIFIC NEWS" for last month, it is stated:—

> "The liquid substratum consists of a mixture of *fused* rock and a *dissolved gas* (in all probability hydrogen)."

It may assist the theory somewhat if an explanation were offered for the existence of hydrogen at such low depths and so intimately associated with the fused rock.

Among the many and wonderful properties of the radioactive elements, one of the most recently discovered is that these substances slowly effect the decomposition of water into its constituent elements, hydrogen and oxygen, *in the exact proportions, by volume, necessary for the re-formation of water.*

This discovery must be considered in conjunction with two well-established facts, viz.:—

(1.) Water is capable of percolating to very great depths in the earth's crust—the evidence from hot springs is a sufficient testimony to this. (In the vapours from which, radioactive emanations are *always* present), and

(2.) Radioactive minerals are to be found in rocks, which, although sometimes met with at the surface, possess all the characteristics of having a deep-seated origin.

It must follow, then, that the water, as it percolates between the interstices in the rocks, or even between the composing crystals (for it is very imperfectly understood by what means water *can* reach such depths), is decomposed into hydrogen and oxygen.

The characteristic property of the latter gas affords a ready and sufficient explanation of the fact that little or no free oxygen ever appears at the mouth of an active volcano or ever issues from the surface of a hot spring.

The suggestion may even aspire to explain the universal existence of oxygen in combination with all the elements composing the earth's crust.

With respect to the hydrogen, that which has been liberated nearest to the surface of the earth may conceivably make its way up again into the atmosphere; that which became free at lower depths may find its way to a point of weakness (such as would be offered by a volcanic area), and make its escape in a more sudden and disastrous manner; while the hydrogen that was formed at the lowest depths, finding it impossible to escape, owing to the pressure above and other causes, might possibly become incorporated with the rock in its vicinity in such a way as to supply the *dissolved gas* which Fisher's theory requires.

Fisher assumed the existence of a liquid substratum (beneath the earth's crust), which is saturated with gases, and, therefore, expansible. If the capacity of molten rock for dissolving gases is similar to the solubility of certain gases in water, then there would be no tide in the substratum which would affect the level of its surface or cause any rise or fall of the overlying crust, which proves, what Fisher maintains, that there are no terrestrial tides.

If it be admitted that the interior of the earth is either molten throughout or liquid to a certain depth, and then a solid nucleus, then it must follow that terrestrial tides *do* exist. But the most weighty evidence on this point is not that supplied by actual observation, but by calculation based on the above assumptions. B. I.

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Astronomical Observation and Spectacle Wearing.

By S. L. SALZEDO.

MANY persons are no doubt under the impression (as the writer was for many years) that the wearing of spectacles is a complete and effective hindrance to the use of a telescope. This may result in the loss to astronomy of people who might develop into enthusiastic workers. In order to demonstrate the error of this view it is sufficient to deal in turn with the various defects of vision for which spectacles are prescribed, and to show how they are overcome.

The defects of vision which are corrected by means of spectacles are four in number; they are :—

1. Myopia (short sight).
2. Hypermetropia and presbyopia (long sight and old sight).
3. Astigmatism.
4. Muscular imbalance.

In myopia, hypermetropia, and presbyopia the only purpose and effect of the lenses prescribed is to supplement the defective focal length of the eye. The telescope, however, is able to supplement the focus of normal vision by a very large amount in either direction, *i.e.*, to shorten or lengthen the focus, thus performing the very same function as the glasses worn before the eye. These defects may, therefore, be completely disregarded.

Of the remaining two visual defects, No. 4, that of muscular imbalance, is a matter of defective co-ordination of the visual axes of the *two* eyes, and is entirely inoperative where *one eye alone* is used alternately.

The fourth defect of the astigmatism is due to defective sphericity of the eye, and is corrected by means of a lens ground to form a section of a cylinder, either in combination with any of the other lenses or alone.

This defect is *not* susceptible of correction by the optical structure of the telescope. It needs to be dealt with specially. As the writer is fortunate enough to possess three of the above defects in combination (hypermetropia, muscular imbalance, and astigmatism), he has been compelled to devise a method of correcting the astigmatism likewise. This may be done very simply :

Having ascertained the power of the cylinder required, have an ordinary sunhead carefully fitted, in place of the dark glass, with a cylindrical lens of the required strength. The axis of the cylinder should be indicated by a line on the outside of the cap for the purpose of adjusting to the astigmatic axis of each eye. In most cases the astigmatic axes of the two eyes are different. It would, therefore, be preferable to have two lines cut upon the outside of the cap in such a way that when one line is vertical the axis of the glass is adjusted, say, to the left eye (this line being marked "L"), and when the other line marked "R" is vertical the cylindrical axis is adjusted to the astigmatism of the right eye. This cap may be screwed on to the telescope like an ordinary sunhead, or may be fitted into the screw flange of the eye-piece and the lines brought to the vertical as required.

For this purpose it is best to give the optician the oculist's prescription, explicitly stating, however, that it is only the *cylindrical* glass which is required.

It is perfectly evident, therefore, that no purely optical defect need stand in the way of the enjoyment by all those who desire it of the many delightful hours which may be yielded by the examination of the heavens.

Coast Denudation in England.

By EDWARD A. MARTIN, F.G.S.

IN 1867 the total area of England, excluding the foreshore, and the area covered by the tides, was 32,590,397 acres. In 1900 it had diminished to 32,549,019 acres. In the intervening 33 years, England had diminished in superficial area by 41,378 acres. These are figures which have been furnished by the Board of Agriculture. Taking an acre of land to be worth £25, this would imply a capital loss to the country of over £1,000,000. The total denudation of the land between the years mentioned is in reality greater than shown, since, in the return for 1900, are included the gains which have accrued in those comparatively few coast-line areas where the sea has actually receded.

A similar loss of land had, of course, been going on for centuries prior to the period covered by the return in question, and there are not many parts of the

Brighton Cliff Formation, Resting on Chalk.
(*A*) Rubble-drift. (*B*) Raised Beach.

country where there do not exist local records and traditions of former much greater extensions of the land.

A glance at a geological map of England is sufficient to show at once why it is that some parts of the coast have suffered more greatly from erosion than others. Generally speaking, the more ancient the rocks which form the coast, the more they are able to withstand the denuding action of the waves. Thus we have on the one extreme the iron-bound coast of Cornwall, with its ancient palæozoic rocks, on which the waves have but little effect, and on the other the boulder-clay areas of the Norfolk coast, and of the south-eastern portion of the Yorkshire coast.

During the last two years efforts have been made with a view to call public attention to the loss by coast-erosion, and if possible to obtain national sympathy for the land-owners who have suffered. Individual efforts at groyning and breakwater building are comparatively few, outside the areas of the larger coast-

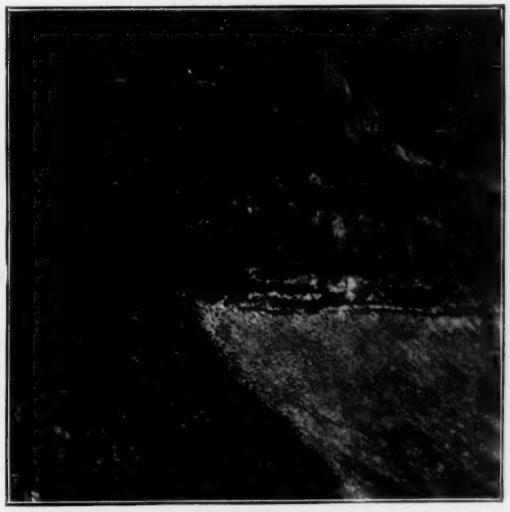
line towns, and with the present value of the land to be salved there is little more to be expected. Mr. A. J. Sauer has recently shown how useless it is to expect much in the way of private enterprise. Taking an acre of land to be worth £25, or about 1¼d. a square yard, and reckoning that for every lineal yard of coast washed away each year two square yards are lost, the total loss would be 2½d. per yard of coast. Defence works vary considerably in cost, but a fair average works out at £19 per yard of coast. Interest on this at 2½ per cent. would amount to 9s. 6d. a year, and with this cost it would be possible to save per annum twopence-halfpenny worth of coast. It is scarcely to be expected that such an unremunerative expenditure would be incurred either by private land-owners or by the State itself. Only where the land in danger acquires a value in consequence of the growth of population do defence works become of a remunerative nature.

The causes of this denuding action of the sea are to be found in purely geological considerations. Ever since the time that this country rose for the last occasion out of the sea, a sea covered with the *débris* of the ice-sheet, which was then commencing to pass away, she has been subjected to the battering-ram action of the tides, and wave-action brought into play thereby.

There is a general agreement amongst geologists that at the time of the uprise of the country from the glacial sea, it rose to a somewhat greater height than that at which it now stands. The evidence on which this is based is formed for the most part in the existence of submerged forests in many parts of the coasts, although on the face of it the existence of a single buried forest is insufficient evidence on which to base an opinion that the part in question at one time stood higher than now. But taken as a whole it may be assumed that England has been subjected, since the growth of these post-glacial forests, to a subsiding movement, and this has brought the areas in question below the level of the sea. When that movement of subsidence ceased, we have nothing to show. So far as existing records show, we can only suspect a movement of subsidence in the historic period, but this lacks positive proof.

For the causes which have resulted during very many years in the gradual wastage of our coasts, we must, therefore, look entirely to marine and aerial denudation, acting as a rule together. In the case of cliffs having a much-jointed structure, or with vertical and diagonal joints and fissures, aerial denudation is as important a geological force as marine. The chemical action of percolating rain in loosening the constituents of some rocks, and the splitting action of such waters under the influence of frost, all tend to degrade the face of a cliff, and the tale is taken up by the tides, by whose action the disintregrated material is borne away to sea.

But in low-lying coast-lines, where the action of frost is slight, or on those shores where, owing to the nature of the material of the cliffs, chemical action is almost entirely absent, there marine denudation is wholly responsible for the loss of acres of land, and where the shores are so low as to be subject even but rarely to flooding, the area covered is at once rendered useless for agriculture, and so receives even less attention than it formerly had, in the direction of protection against the inroads of the sea. Thus, in the end, it becomes permanently lowered by further denudation, until its surface is beneath the level of the sea. But marine denudation, simply, may be the cause of many a noble cliff crumbling away. It is estimated that many of the prevalent storms which arise in the North Sea show their effects on our eastern and north-east coast in waves which beat upon the cliffs with a force varying between two to three tons to the square foot. A change in the nature of the strata in a cliff, owing to the strata dipping at an angle in a direction parallel with the coast, will be sufficient for such a force to find a suitable lodgement on which to play with success. Or it may result in undermining, until the upper parts of a horizontally stratified cliff may project several feet beyond the base of the cliff. In that case a period will be soon reached at which the overhanging portion will fall. Then marine action, which commenced the process by its undermining action, will complete the work by bearing away the fallen material, and redepositing it elsewhere. But such redeposition seldom results in the formation of land elsewhere. It may shoal up a sea, but only to a certain point. Without any subsequent submarine upheaval, the *débris* of the land so denuded rarely results in dry land. Without a counteracting uprise, the tendency of the land is towards complete disappearance beneath the sea. It is not always realised that were the denudation of the land to go forward unchecked, the result would be the complete disappearance of our land areas. In fact, so great is the preponderance of sea-areas that were the earth completely spheroidal, there would be a universal ocean two miles deep. Fortunately, as geology teaches us, time after time the results of the degradation of the land have been rendered nugatory by upheaval.



The Raised Beach, showing Cave-like Holes (*B*) where the Loose Larger Stones at the top have fallen away.

But in our own country, at the present time, we have no decisive evidence that either upheaval or subsidence is going on. Denudation of our coasts proceeds with no check placed upon it by natural causes. It will become a serious question as to whether artificial protection will not sooner or later become an imperative national concern.

The last movement of upheaval which England underwent was that which on our south coasts elevated the raised beaches which are there found, and even though the existence of buried forests seems to show a sub-

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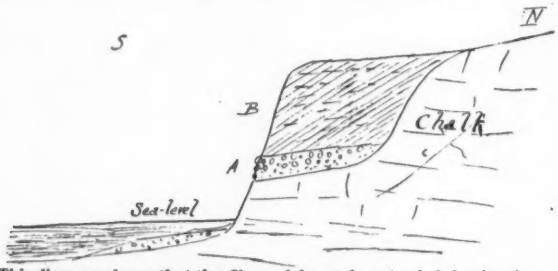
sequent partial downward movement, this was not sufficient to counteract the former upward movement. The result is seen in the raised beaches and rubble-drift formations which have from time to time been described. The Brighton cliff formation is one of the best examples of this kind. The formation occurs at the east end of the town, and owing to its nature is liable to constant falls. Thus fresh sections are frequently being exposed. At the present time, the lower portion of the cliff consists of about ten feet of chalk. Upon this chalk rests about eight feet of beach. This beach was sorted in the same way that modern beaches are sorted now, so that we find upon the chalk a good deal of sand and small pebbles, and these increase in size upwards, until large flint boulders complete the higher portions of the beach. Although the beach is mostly of flints, it also contains a few rolled granite boulders and rounded lumps of red sandstone.

Owing to lack of cementing material in the beach, it is constantly falling on to the lower beach, and cave-like holes are formed. Then, in the course of time, the rubble above it, having lost its natural support, falls on to the beach below, and is rapidly carried away by the sea. The rubble forms the remainder of the cliff.



This diagram shows that the Channel formerly extended further in a northernly direction than now. (*A*) Raised Beach. (*B*) Rubble-drift. Brighton Beach.

It is of a brown colour, and contains numerous rounded and sub-angular pebbles of chalk and flint, varying very much in different parts. It was in this rubble-drift that Mantell found remains of *Elephas primigenius*, and hence the name of Elephant Bed sometimes applied to it locally. *Rhinoceros tichorinus*, *Cervus elaphas*, and *Hippopotamus major* were also found.

The nature of the animal contents shows that the time of its formation (Pleistocene), although geologically of fairly recent date, was yet far removed, if one counts by years, from existing times. The upward and then the partial downward movements which have since occurred, have now completely come to a standstill, but the denuding action of the sea continues, and this in so porous a material as the rubble-drift is aided by sub-aerial denudation. Where the coasts are formed entirely of chalk, erosion by the sea is not so marked, although it is far from being negligeable. But when we look at our eastern coasts, and consider the fragile nature of the material of which our cliffs are there formed, we almost wonder that coast erosion has not been more marked than it has been. The boulder-clay cliffs of south-eastern Yorkshire render that coast peculiarly liable to denudation. The inlet of the Wash was brought about by the friable nature of the strata when once the chalk had been breached. The glacial and crag cliffs of Norfolk and Suffolk, and the London Clay cliffs of Essex all afford yielding material to the inroads of the sea. On the north of Kent, the London Clay is constantly slipping into the bed of the sea, together with other loosely-accumulated material of tertiary age.

When one looks at a map of our country, one cannot help being struck with the fact that it is not a little remarkable that the great bulge of the east coast is just in those parts where the coast-line is least protected. Our oldest and most indurated rocks are, on the whole, on our west coasts. In general our strata dip from west to east, and this has been brought about by a tilting movement, which has exposed the edges of upturned rocks of older date, as one proceeds westwards. The coming of the North Sea may have been materially assisted by this movement, and since its advent, the sea has steadily continued to work backward, until, in-

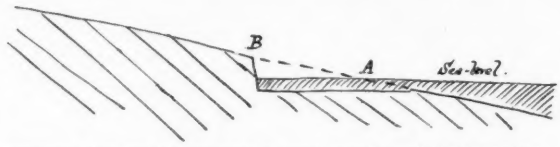


Diagram showing the progress of coast erosion and the formation of cliffs on the East Anglian Coast: dip greatly exaggerated.

stead of breaking on a shelving strand, as it would have done at A, it has, by ceaseless erosion, produced the cliff at B. This is, in effect, the condition in which we find the cliffs in East Anglia. As a matter of fact, the very existence of sea-cliffs is evidence of erosion, whether the cliffs be formed of igneous or sedimentary materials; but to go back to the time when that erosion commenced, one must go back to that time when the country last emerged from the sea. The task which engineers have now set themselves is to protect the shores as they now are, and from a discussion which took place at a recent meeting of the Institute of Civil Engineers, it seems to be generally accepted that defence works have, as a rule, been pushed too far sea-ward, as though to reclaim some of the land which the sea had already swallowed up years ago. The result has been disastrous to the unprotected areas in close proximity. To mention two instances only, we find the scouring out of East Wear Bay largely owing to defence works at Folkestone Harbour, and the rapid succession of falls of the cliffs at East Brighton are directly owing to the scour of the tides after passing the town's defences. There has been too much of the desire on the part of the local authorities of those areas which could afford defensive works to benefit at the expense of those owners whom it would not pay to make great outlays. It is well that engineers recognise this, since in their individual capacity they are responsible for the erection of all such defence works.

Roman Coins at Hull.

THE Municipal Museum at Hull has recently acquired an extensive and valuable addition to its collection of local Roman, &c., remains.

It consists of the life work of a somewhat eccentric character, Tom Smith, of South Ferriby, locally known as "Coin Tommy."

The specimens are principally of Roman date, and include over 2,000 coins, nearly 100 fibulæ of a great variety of patterns, several dozen buckles, pins, dress fasteners, ornaments, strap ends, bosses, spindle whorls, armlets, spoons, beads, objects of lead, &c. Amongst the fibulæ are two of altogether exceptional interest, as they bear the maker's name upon them (AVCISSA). Only two examples of brooches marked in this way have previously been found in Britain (in Somerset), though they are recorded in France, Germany. Italy, &c.

There is also an extensive collection of pottery, including many vases, strainers, dishes, &c., in grey ware, as well as many fine pieces of Samian ware.

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Photography

Pure and Applied.

By CHAPMAN JONES, F.I.C., F.C.S., &c.

Reversal and Re-Reversal.—It was about five and twenty years ago that M. Janssen observed, when photographing the sun, that, with the particular sensitive plates he was using, an exposure of from one to two hundred thousand times the suitable exposure for an ordinary image gave on development a positive instead of a negative, and that by increasing the exposure to about a million times the image was again reversed, though with a considerable diminution of contrast. These observations, expressed in the simplest form, indicate that a gradually increasing exposure followed by development, will give at first an increasing darkness of deposit, then a diminution of density, followed by another, though less marked, increase of density; and there seems to be some evidence that this alternating rise and fall of density resulting from a continually increasing exposure, might go on until the differences were too small for observation if interfering circumstances did not step in to vitiate the experiments. It has further been suggested that the image utilised in ordinary negative making is not the first result of the action of light, but is preceded by a similar alternating action to that which seems to follow it. If this is so not only is the result of the continuous action of light of an alternating character, but the maxima first increase and then diminish, the effect passing, doubtless, into changes of a different character.

It is easy to prove the increase of density with increase of exposure as in ordinary negative making, and then a decrease as in the reversal resulting from over exposure, but to get further than this is, experimentally, so difficult that many have tried and failed, and not a few have, therefore, doubted Janssen's original observations, and believe only in one increase followed by one decrease in density. What appears to be a definite proof of a second increase of density has lately been supplied by M. Adrien Guébhard, who, in the *Comptes Rendus* (CXLI., 559), gives a reproduction of the result of one of his experiments. A Lumiere film was exposed to daylight for forty-four days last August and September, including only nine dull days, under a graduated screen made of white paper arranged in from one to twenty-two thicknesses, covered with a cut-out black paper screen. The film was then developed for five minutes in an ordinary metoquinone developer. Confirmatory results were also obtained on Eastman Kodoid films.

The total exposure of forty-four days may seem excessive in dealing with a series of only twenty-two exposures, but the exposure durations have to be in a geometric series. An initial exposure of approximately one second in a series of twenty-two, if each is double the preceding, would require about the time stated for the last. The impossibility of confining the light action to the part required is a very great difficulty in such an experiment, because of reflection within the film. For any who wish to test the matter for themselves, and reliable confirmation of the results obtained with an extension of them as far as possible would be very welcome to all interested in the study of pure photography, I would make the following observations :—

A pure bromide emulsion (free from iodide) gives a much more quickly reversible image than the ordinary mixture of bromide and iodide. One considerable disadvantage in the use of commercial preparations is the uncertainty as to what they contain. Some plates now on the market are not simple emulsions of silver salts, and it seems at least probable that even the makers do not know what they contain, although, of course, they know what they use in their preparation. But still, experiments with commercial plates are interesting and may be useful. To avoid the interference of the long exposures with the comparatively short exposure effects, I would suggest getting the shorter exposure by means of a graduating device, such as what is commonly known as a Spurge's sensitometer, and for the longer exposures using separate parts of the sensitive material each quite isolated from the other by being contained in a separate compartment of a multiple-cell box, or one of a number of small boxes. The exclusion of vitiated air, the avoidance of complications due to temperature changes, the results of comparative blank experiments to discover any interfering circumstances that may be present, the distinction in the result between printing-out and development effects, and other such matters must, of course, be taken into consideration.

Shading the Lens.—The importance of so shading the lens, especially when working out of doors, that extraneous light is excluded from the camera, is not recognised now as it used to be, and never was generally recognised as it ought to be. If the glass of the lens were perfectly transparent, its surfaces perfectly polished, the interior of the mount of the camera perfectly non-reflecting, and the air perfectly free from motes, there would be, perhaps, no advantage in shading the lens; but such conditions are impossible. The hood generally found on old lenses, but often not on new ones, is a little better than nothing. Years ago some photographers made large conical hoods, almost reminding one of small gramophone trumpets, and these were used even in studios with advantage; but this is not the kind of thing that will best serve the purpose. It is obvious that the shape of the opening at the outer end of a large hood or shade should correspond to the shape of the plate or that part of the plate that is to receive the desired image. If a light bellows could be attached to the camera front so that it could be opened out to extend a few inches in front of the lens, and carry at its outer extremity a screen with an adjustable rectangular opening in it, the shading of the lens would be ideal. This principle, but without the possibility of adjustment, may be easily carried out in those hand cameras in which the lens is within an outer case. The opening in the front of the case may be so made that while the plate is fully illuminated, all the light that can be safely cut off is prevented from entering the camera.

There is also advantage in using a camera made to carry a larger plate than that used and in fitting lenses into mounts of a larger diameter than is necessary just to hold them, as in both cases the reflecting walls are further away from the path of the light being utilised, and the reflection is reduced. In spectroscopy and photo-micrography these matters are of considerable practical importance.

The Optical Projection of Opaque Objects.—A piece of apparatus that deserves to be more widely known is the "Picture Postcard Lantern," made by Messrs. W. C. Hughes and Co., of Mortimer Road, Kingsland. It consists of a well-made and capacious Russian-iron lantern, within which are two incandescent gas burners, one on each side, that illuminate the card held in a carrier at the back, and a lens in the front of the lantern that projects the image on to a small screen three or four feet away. While originally meant for

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picture postcards, it will give an enlarged image of any paper print or diagram, or of the page of a book without injuring the book in any way. The image as given directly is, of course, laterally inverted, but where this is a drawback, as in the case of figures or letters, this is easily obviated by fixing a piece of silvered plate glass (thin patent plate silvered on the back serves well and is easily obtained in front of the lens and receiving the reflected image on the screen. In addition to the obvious uses of such an apparatus, one can, by its means, judge at once from a small print whether an enlargement of it would be of advantage, and it will often save the trouble of making a lantern slide and arranging an optical lantern.

The Glastonbury Grace Cup.

PEG-TANKARDS are of the Saxon period. A fine specimen of Anglo-Saxon work, formerly belonging to the Abbey of Glastonbury, is now in the possession of Lord Arundel, the noble owner of Wardour Castle. This old relic is known by the name of the "Glastonbury Cup," as tradition says it was carved out of a piece of the Holy Thorn on Weary-all Hill, when Joseph of Arimathea rested and planted his staff, which, like Aaron's rod, "budded and flowered." It is also known as the "Grace Cup," and the old belief still exists that it is

Photo. by W. Tully, Glastonbury.
Grace Cup in Wardour Castle.

the original Glastonbury Cup which was used as a Grace Cup after meals in the refectory by the monks of the Abbey. It is made of wood, and rests on crouching lions, the bowl being carved with the twelve Apostles. On the lid, the Crucifixion is carved, with the Virgin Mary and St. John. The Cup holds two quarts, and originally had eight pegs placed one above another inside, dividing the liquor into equal quantities of half a pint each.

The Rule for the Infinity Focus.

By DR. G. H. BRYAN, F.R.S.

MOST instructions sent out with cameras contain somewhat dogmatic statements as to the distances at which objects are in focus with a certain stop. It is surprising that so few people know the very simple rule for such matters.

Let a camera be focussed for "infinity," that is, for parallel rays (as in the cheaper box cameras), and let it be directed at a near object. Take two points on the object, whose distance apart is equal to the diameter of the stop. Then it is just possible to draw a couple of parallel rays from the two points to the lens, and these extreme rays will converge to the same point on the negative. If the points are further apart, no rays from one are parallel to rays from the other, nor do they consequently converge to the same point on the negative. We thus have the following result:—In a fixed focus camera the impressions produced on the plate or film by two points of a near object will overlap if the distance between the points is less than the diameter of the stop. If the distance between the points is greater, the impressions on the plate will be distinct.

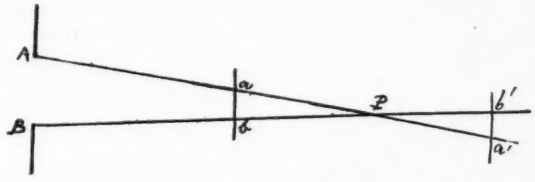
In most cameras the stop is placed between the lenses. On looking through the front lens the stop appears slightly magnified, and a little simple reasoning shows that it is this magnified diameter, not the actual diameter of the stop, that must be taken.

For instance, if, on looking into the lens, the stop appears to be half an inch in diameter, no objects less than half an inch apart will produce separate impressions; half an inch is, therefore, the limit of size of the details which can be shown in the photograph. It makes no difference whether the objects are near or far away. If they are near, details below half an inch in size may be large enough to appear blurred on the negative, if they are far off, such details may be unnoticeable, but if the negative be enlarged to the same size as before they will present the same appearance as before, other circumstances being left out of account.

Another consequence of the rule may be noted. With a lens of four inches focus, the limit of detail will be one inch for stop f/4, and $\frac{1}{4}$ inch for stop f/16. With a lens of one inch focus the limit of detail would be $\frac{1}{4}$ inch for stop f/4, and 1-16th inch for stop f/16.

Suppose, then, that instead of taking quarter plate negatives with a four-inch lens, we were to take negatives measuring about 1 inch by $\frac{3}{4}$ inch with a lens of one inch focal length and a corresponding stop, and suppose we were to make enlargements of the same size from both negatives. Then the enlargement from the smaller negative would show four times the detail in focus at all distances; that is, details of $\frac{1}{4}$ inch would be in as good focus in the enlargement of the smaller negative as details of one inch in that of the larger. By carrying a very tiny camera about in his watch pocket and trusting to enlarging, a photographer might be practically independent of focussing even for very near objects indeed, but for the fact that imperfections and coarseness of grain in the negatives would be enlarged correspondingly.

The corresponding rule for a camera focussed for a finite distance is best shown with the aid of the accompanying figure. If A B represents the stop or its magnified image as seen in the front lens when focussed on a point P, at any given distance, details at any other distance will be separated in the photograph if



their distance apart exceed the breadth of the cone A P B at that distance. For instance, *a b* and *a' b'* show the distances apart of points when the impressions they produce in the photograph just cease to be separate.

I found these rules of great use during the recent visit to South Africa, and the results obtained were in complete accordance with them, especially when other conditions were taken into account.

CORRESPONDENCE.

Green Flash at Sunset.

I would call attention to a phenomenon of atmospheric refraction frequently observed, but of which very little has been published. I refer to the green flash seen in clear weather as the last ray of the setting sun disappears. I observed this one evening in the N. Atlantic last month, and I also saw it in the N. Atlantic in October, 1898; on this last occasion I watched Venus setting a little later, but though the planet turned red occasionally as it approached the horizon, it did not flash green at the last moment. I have, however, seen stars set with a green flash, but rarely.

The phenomenon is noticed in "KNOWLEDGE" for April, 1889, p. 126, here the colour is given as blue; in "Nature," March and April, 1890, pp. 495, 538; and in R.A.S. notices, May, 1901. In these notices the writers appear to hold different views as to the cause. In Elementary Meteorology, by Professor W. M. Davis, p. 50, it is stated that after sunset every solar beam will be broken into a short vertical spectrum; is this the explanation? If so, why should the last flash be green (according to some accounts, of a remarkably vivid green)? I would like to see the matter worked out.

J. P. MACLEAR.

Chiddingfold, 19th Dec., 1905.

[Admiral Maclear's letter opens up the subject which has for a very long time formed a topic of discussion, especially among voyagers at sea. We have always held the belief that the phenomenon is solely due to the optical effect, so well known, of a complementary colour appearing on the withdrawal of any very brightly-coloured object. If you look at the sun and then close your eyes, a brilliant green image will be seen.—ED.]

The late Prof. Howes.

WE are requested to announce that the endowment fund now being raised for the family of the late Professor G. B. Howes, F.R.S., will be closed shortly, and all intending contributors are asked to send their contributions without delay to the Treasurer, Mr. Frank Crisp, at 17, Throgmorton Avenue, London, E.C.

Influenza and the Weather.

To the Editor of "KNOWLEDGE AND SCIENTIFIC NEWS."

SIRS,—In your issue of November there was a most interesting article from the pen of Mr. A. H. Bell *re* the above subject. It is a subject of the utmost importance to the public, for a ravage of influenza has in its tiny germ as deadly a killing factor as shot and shell in a big war. That Mr. Bell is perfectly right, most doctors who read his article will perfectly agree. Most will also see in the much abused east wind one of Nature's best antiseptics, so that instead of being the sower of disease we would rather look upon it as a trying but invigorating friend. True, it may be a dread to the very young, the very old, and to the feeble and confirmed invalid; but to the great mass of mankind it certainly does not deserve all the scape-goatish epithets flung at it.

From personal experience I can corroborate every word written by Mr. Bell, for it has been my fortune, or misfortune, to contend with more than one attack of severe influenza whilst practising in England.

In a large country practice I found that in no case did influenza spread except by the contact of the healthy with the affected.

Farmers and their wives had it first, then their families, lastly their servants. Time after time noticing that those who did the marketing were the first to be struck down, convinced me that influenza chiefly spread by contact.

In the Blue Book which Dr. Franklin Parsons drew up for Parliament when the first severe visitation of influenza some 20 years ago visited Great Britain, there is a report of mine bearing out the opinions so clearly set forth by Mr. Bell in his article in "KNOWLEDGE." In a conversation I had with Dr. F. Parsons he, too, was fully convinced that climatic changes had little to do with the spread of influenza, and in coming to that conclusion he had his own observant mind guiding him, as well as the experience of others.

I am, dear Sir,
Yours truly,
T. PICKTHORN THOMSON,
C. S. *Duplex*,
Suez, Egypt.

Venom of Spiders.

TO THE EDITOR OF "KNOWLEDGE."

SIRS,—I have read with great interest Mr. C. A. Michell's letter relating to the venom of spiders. I have always had great interest in this subject, and have studied it for many years.

When I was a boy at school I was very fond of natural history, and used to spend much of my spare time collecting specimens. One day I succeeded in catching a very large black spider, but unfortunately I did not notice the variety, Having nowhere to put it, I placed it in a box containing two frogs. To my surprise next morning I discovered that one of the frogs was dead and the other very torpid, and succumbed in a few minutes. The spider was quite lively, and when disturbed with a straw attacked it furiously.

Happening to mention this fact to our old gardener, who had a great reputation in the village for his knowledge of wild things, he declared that the bite of a spider was fatal to all small creatures, but only during a certain part of its existence. Wishing to prove this I tried the next night with another frog. In the morning the frog was dead, but the spider had unfortunately escaped. I tried several times after this, but these were the only cases in which the frogs were killed. I shall be much obliged if any of your readers can inform me to which variety my spider belonged. I have never since seen one like it. The points that struck me most about it were its great size, its broad, smooth back, and the orange stripe along the lower side of its body.

E. T. Z. D.

The Elms.

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Answers to Correspondents.

Altitude of the Sun. In the note in the January number the declination should, of course, read 23° 3′ 28″ instead of 28° 3′ 28″, which alters the calculation.

B. Lomax. "*Baily's Beads.*" Just before a total eclipse of the sun, and when but a very narrow rim of the sun is visible, this thin line suddenly becomes broken into detached spots of light caused by the irregular (mountainous) surface of the moon. This phenomenon was first noted by Francis Baily in 1836.

J. H. The resistance of the air to a surface moving against it is not quite as you put it. The formula should read:

$$P = V^2 X$$

when P = Pressure in lbs. per square foot.
V = Velocity in miles per hour.
X = A constant which varies according to different experimenters, but may be taken at about ·003.

It is very generally supposed that a bird gains a certain amount of lift even during the upstroke of the wings. There are, unfortunately, a large number of inventors anxious to obtain funds for constructing their models, but, considering the very great amount of time and money which, without doubt, must be expended before a successful flying machine can be constructed, our advice to those not having such commodities at their disposal is to leave the matter alone.

REVIEWS OF BOOKS.

Nebula to Man, by Henry R. Knipe (Dent and Co.; price £1 1s. net).—This is a fine work—original, poetic, and sublime. It treats of the history of our planet from its very birth, and the evolution of life-forms down to man. Such a subject, so vast in its magnitude, yet so hypothetical in its nature, is appropriate to verse, and accordingly this history of an eternity forms a great poem, descriptive of what we know, or presume we know, of ages long gone past. The interest and attractiveness are greatly added to by the profusion of well-designed and well-executed illustrations. Many of them are coloured plates, and represent various scenes in bygone times, from views of nebulæ and landscapes in the different geological periods, queer denizens of the earth and waters, down to prehistoric man. Quite a number of artists have contributed to this interesting collection. If the whole is naturally to some extent fanciful, the facts introduced are well authenticated, and the notes at the end of the book supply references to the sources whence these facts are culled. To give some idea of how such a subject is treated in verse, we may quote a few of the opening lines, and if the poetry be not of the highest order, it is, at all events, well-worded and pleasing—

> A glowing mist, through realms of space unbounded,
> Whirls on its way, by starry hosts surrounded,
> Dim is its lustre, as compared with theirs,
> And more the look of stars dissolved it wears.

The following, too, may exemplify some of the apposite ideas included—

> Perchance descended from those gauze-winged flies,
> That flitted joyous 'neath Devonian skies,
> In places now some butterflies are seen,
> Gay colours bringing to the sombre green.
>
> * * *
>
> How great and varied, Nature, are thy powers!
> Those monster reptile forms, those flying flowers!
> And can it be that in some far back age
> In one life-form both had their parentage?

We hope this is a correct quotation, although there is an evident misprint in the book in the fifth of the lines quoted above.

The Uses of British Plants.—By an oversight we omitted to mention in our last number that this book is by the Rev. Prof. G. Henslow, M.A., and is published by Lovell, Reeve and Co.; price 4s. 6d. net.

The Nature and Origin of Living Matter, by H. Charlton Bastian, M.A., M.D., F.R.S., &c. With 245 illustrations from photo-micrographs. Medium, 8vo. (Fisher Unwin; 12s. 6d. net).—Dr. Charlton Bastian has produced a work replete with interest. The views expressed, and the conclusions drawn, are not seldom unorthodox; yet, the author has great respect for the opinions of others, in spite of—and not unnaturally—a decided leaning towards his own, missing no link in the chain of reasoning which will convince the reader of their soundness. The earlier chapters will repay attentive perusal, as leading up to what might be thought the more fascinating problems of "Spontaneous Generation" and the Heterogenetic origins. Dr. Bastian rightly lays stress on the "Uniformity of Nature," as the basis of the hypothesis of evolution, for without this "Uniformity" our knowledge of the past, and insight of the future, would be indefinite and futile.

Certainly, Aristotle did not hold this view, nor could it be expected that he should, since it is time alone that has driven "Chance" and "Spontaneity" from their position in nature to be replaced by law and order.

Evolutionists generally are not at one with the author's more advanced views on the occurrence of Archiebiosis. The belief of the majority is that living matter came into being once only, and that in the distant geological past. Dr. Bastian has Haeckel and Carl Nägebi with him in the belief that Archiebiosis has been repeated times without number, and also that it arises *de novo* now.

How the formation of organic material from the inorganic is, or was, brought about may remain a profound mystery, whichever view be held. It must be admitted that Dr. Bastian's researches into the natural origin of living matter, from their inherent difficulties, have not, with any certainty, convinced us that spontaneous generation does take place, although his arguments and conclusions, founded on his practical investigations, help us to realise that its existence is not a myth. To hold a biassed opinion on this question, Rücker has well said, is "to beg the whole question at issue; to decide the cause before it has been heard." Pasteur was convinced of the impossibility of "life existing without an anterior and similar life," having failed to find proof of it after twenty years' labour. Dr. Bastian is equally positive that Heterogenesis is a reality. Thirty years ago he turned his thoughts to the doctrine of Heterogenesis; the evidence brought forward in its favour, is that of a mature observer, working in Nature's laboratories in quest of her secrets. The conclusions drawn harmonise with the accumulation of evidence arising from observation and experiment, and all that is expected is that they be the subject of impartial consideration. The views advanced do not postulate any inexplicable departure from the uniformity of Nature. Before us is a volume which will make thinkers ponder the more, and should stimulate scientists to fresh endeavour to emulate the author in attempting to solve the problem of the nature and origin of living matter.—S. G. M.

The Bontoc Igorot, by Albert Ernest Jenks, Department of the Interior U.S. Ethnological Survey Publications; Vol. I. The United States Government is preparing to consolidate its dominion over the Philippine Islands by a scientific survey, not alone of the physiographic aspects of the new territories, but of the anthropological attributes of the peoples who are to be governed. It is an example which may be commended to the notice of the British Government, and the first of the publications of the new survey is in many respects a model publication. The Bontoc Igorots, who are a tribe living in the interior of the northern island of Luzon, were selected for examination; and Mr. Jenks, the Chief of the Ethnological Survey, accompanied by his wife, spent some six or seven months among these primitive people, photographing, measuring, observing; and learning their language. The results are embodied in the work before us, a heavy volume—though heavy only in the physical sense—well illustrated by between one and two hundred photographs, diagrams, figures, and plans. The Bontoc Igorots are a simple race, industrious agriculturists, with hardly any vices, no pastimes to speak of beyond the stimulating sport of head hunting, and remarkably few beliefs or prejudices. They are good natured, kindly and generous; and they are, one would say, a race well fitted to live long. They are of good physical development, neither tall nor short, fat nor emaciated, and suffering from no organic diseases. Yet—such are some of the paradoxes of the simple life!—they grow old at forty-five, they are quite old at fifty-

five, and hardly ever live to seventy. The only reason which in this bulky and interesting monograph we have been able to discover for their failure to live to a hundred, is in the recipe for one of their beverages. It is called "sa-fu-eng," and is prepared as follows: "Cold water is first put in a jar and into it are thrown cooked rice, cooked camotes, cooked locusts, and all sorts of cooked flesh and bones. The resulting liquor is drunk at the end of ten days." Mr. Jenks says that it smells worse than anything else in Bontoc; and he is puzzled to account for the absence of fatal consequences. To our minds it shows only what fine constitutions these primitive people possess; though the fact of the shortness of their days is still unaccounted for.

Of **Jack's Scientific Series** (T. C. & E. C. Jack; price 1s. each) we have received five new volumes. **Meteorology,** by J. G. McPherson, Ph.D., F.R.S.E., is a handy little book, containing a number of interesting facts in all branches of meteorology. But the composition is not as satisfactory as it might be. There seems to be a strained attempt to make the language simple and childlike, and yet much of it is far from being clear, even to the intelligent reader. For instance, what is meant (on p. 92) by "The leading winds are under the calculation of the meteorologist, but the others will not be bound by laws"? It seems rather superfluous to tell us "The soft rain on a genial evening or the heavy thunderstorms on a broiling day are too well known to be written about" (though such subjects would seem to be the object of the book), and "Sometimes rain is earnestly wished for, at other times it is dreaded, according to the season."

Sociology, by C. W. Saleeby, M.D., is another of the series. Whether "Sociology" can be called a science, and divided into "pure Sociology" and "applied Sociology" is a matter that we need not here discuss, but the author himself does not lay stress on this point, and merely goes ahead to relate in comprehensible language some of the leading facts which are to be included under this head. Part I. consists of a general survey of society, sexes, and social organism, together with the origin and future of Religious Belief. Part II. deals with such subjects as Education, Society and Crime, Socialism and Politics. Two more books of the series are by the same author, Dr. Saleeby, and on very kindred subjects. **Heredity** discusses modes of reproduction, facts and laws of Variation, Mendelism, and Inheritance. **Organic Evolution** treats of the Evolution of Life, Natural Selection, and one chapter—which will doubtless be generally sought for—on the Future Evolution of Man. Here, the author tells us, we may look for improvement. Not only is the intelligent and the conscientious man more likely to gain the admiration of a fellow-woman, but, what is nowadays more practically important, such an individual is more likely to gain a post, giving him the means to marry. **Psychology** is yet another volume by Dr. Saleeby, and this treats of the Evolution of Mind and Will, Association of Ideas and of Sensations, and ends up with a chapter on Psychical Research.

The Voyage of the "Discovery," by Capt. R. F. Scott, C.V.O., R.N., 2 vols. (Smith, Elder, and Co.; price 42s. net).—A book of this nature, a record of three years of travel, and a record which must bear the stamp of an official report, cannot but be bulky, and there is more than this to be included. A general history of Antarctic navigation is a fitting introduction to the story, and then a full account of the inception of and preparations for this particular expedition must necessarily follow. Once started on the voyage all is plain sailing, and from Christmas Day, 1901, till September, 1904, an almost daily account of life and adventure in the Antarctic is presented. It will not be necessary here to repeat any of the tale which is told. The book is written in a style that needs no translation, clear, and without technicalities, and the detail of life in those dreary wastes and inhospitable climes is rendered full of interest. Moreover, much of it is exciting reading. Some of the thrilling adventures met with are graphically described, and the accounts of fierce gales howling around the ship fast in the ice, snow drifting deeply and almost burying the whole vessel beneath it, the windmill wrecked and chimneys damaged, but all the while the crew joining in a humorous discussion on "Women's Rights," are truly exciting and diverting. The naturalist, the geologist, and the meteorologist will find much matter of interest. What with penguins and very many other birds, to say nothing of whales and seals, there is plenty of life to describe, while two Appendices treat of the geological observations, the zoology being contributed respectively by Mr. Ferrar and Dr. Wilson. The numerous illustrations, mostly from photographs, are excellent, and charts of the track complete this very readable and valuable work.

Smithsonian Institution Annual Report (Washington: Government Printing Office).—This report, besides containing the official and financial statements of the Institute, is full of interesting communications on various subjects. These include an account of experiments with the Langley Aërodrome; A paper by Professor Poynting on "Radiation in the Solar System"; a suggestive paper by Sir William Ramsay on the "Present Problems of Inorganic Chemistry"; one on the "Pearl Fisheries of Ceylon," by Professor W. A. Herdman; and many on "Archæology" (chiefly American). It is altogether a fascinating volume, attractive to almost every type of reader.

Guide to Finger-Print Identification, by Henry Faulds (Hanley: Wood, Mitchell, and Co., price 5s.). Now that finger-print identification is coming so much to the fore in criminal proceedings, public interest in the subject is naturally great, and this small book provides methods of identification. The author goes to some pains to explain that it is a popular fallacy to connect this subject with the name of M. Bertillon, whose system is wholly anthropometric. He, moreover, has failed to find corroboration of the oft-repeated statement that finger prints have been used for identification in China and elsewhere. But there seems almost too much space devoted to a collection of evidence to try to prove that the author was the first to introduce the subject. Like most others, this subject has only gradually come forward, and many, but especially including Mr. F. Galton, have had a hand in giving it the publicity it now enjoys. As a guide to the practice this book is decidedly disappointing, though it contains a number of useful facts scattered among its pages, and is clearly illustrated, mostly from enlarged photographs.

Nature through the Microscope and Camera, by Richard Kerr, F.G.S., F.R.A.S. (London: Religious Tract Society, 1905).—The number of people who find keen enjoyment in the study of the beautiful in nature is far greater than many would suppose. And though such students care little for the things that concern the systematist, they incidentally render him yeoman service. This is especially true of those who pursue the study of the infinitely little in nature, for to them we owe some of the most valuable advances in the evolution of the microscope. This really handsome volume is written especially for those who regard nature as a sort of Aladdin's cave to be exploited through the microscope. The richness of the spoils to be gathered in such hunting are not easily described, but some idea thereof may be gathered by a glance through the many beautiful illustrations which adorn the pages of this work. The store of good things which this cave of living wonders contains is limitless. Diatoms, and molluscan teeth, caterpillars' eggs, beetles' legs, the stems of plants, and the human skeleton are all shown to contain hidden and unsuspected beauty. Dr. Sims Woodhead has written an admirable introduction to this book, and Mr. Arthur F. Smith has contributed a really valuable chapter on "Practical Hints on Photo-Micrography."

Second Stage Inorganic Chemistry (Theoretical), by G. H. Bailey, D.Sc. (Lond.), Ph.D. Edited by W. Briggs, LL.D., M.A., B.Sc.; pp. 8 and 542; 3rd Edition (London: W. B. Clive; price, 4s. 6d.).—Although this book is primarily intended to cover the ground included in the syllabus issued by the Board of Education it is yet more than a mere "cram" book and can be studied with interest by those who have not the fear of examination ever before them. It has been brought thoroughly up to date, and gives, for instance, a clear summary of recent discoveries about radium emanations and the "contact" method of manufacturing sulphuric acid. The text is illustrated by diagrams and figures of apparatus; experimental work is described wherever possible; and each chapter has a series of questions which will be found of the greatest use.

Future Forest Trees, by A. Harold Unwin, Assistant Conservator of Forests, Southern Nigeria (T. Fisher Unwin; pp. 108, three full-page illustrations; price 7s. 6d. net).—This book is likely to be of great utility, in view of the increased interest which is being taken in the question of re-afforestation

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in our own country. At the end of the 18th century Germany foresaw the importance of introducing certain American trees into that country, about 300 species being chosen. Some of these have become established, and this book gives an interesting account of the experiments tried by the German Government, and also of their failures, and the cause to which failure was due. The question of tree-planting is likely to be an important one in our own country, in view of the rapid disappearance of our forests and woodlands, and the very small amount of re-afforestation which takes place. Here there is good work to be done. In the ranks of the unemployed the necessary labour can be found. The institution of "Arbor-Day" is a step in the right direction, but whatever is done in the future, it will prove of great value to have a guide as to what trees will, and what trees will not, be suitable by way of increasing our own tree-flora, and in this useful work there will be found a guide, from experience, of what experiments are likely to lead to failure, and what to success.

The Central Tian-Shan Mountains, by Dr. Gottfried Merzbacher. Published under the authority of the Royal Geographical Society (John Murray, pp. 285; 20 illustrations and folding maps; price 12s. net).—This magnificently-produced volume deals in detail with extensive exploration of the Tian-Shan Range in the years 1902 and 1903. It does not profess to be an exhaustive account either of the range or of Dr. Merzbacher's explorations, but it is sufficient to give an idea of the magnificence of the heights which he scaled, and the grandness of the glaciers which he crossed or viewed. The illustrations are as a rule full page, and are from very fine photographs. From the point of view of the mountain-climber, the book is of intense interest.

Elements of Mineralogy, by Frank Rutley, F.G.S.; 14th edition, revised and corrected. (London: Thomas Murby and Co.; pp. 251, illustrated.)—We welcome this edition of a well-known manual, packed full with material valuable to the mineralogical student. Particularly to be noted are five pages of very clear diagrams illustrating the various systems of crystallography, and the additional chapter on "Radio-Active Elements," by Ernest Howard Adye.

The Fungus Flora of Yorkshire, by G. Massee, F.L.S., and C. Crossland, F.L.S. (London: A. Brown and Sons, Farringdon Avenue; pp. 396.)—This book is an admirable summary of work done during many years by members and friends of the Yorkshire Naturalists' Union. It is modestly claimed that the work is but a "contribution" to the subject of the fungus flora of Yorkshire. That may be so, but it should serve as an example to other less active local natural history societies.

The Preparation of Manuscripts for the Printer. By Frank H. Vizetelly. (Funk & Wagnall's Company; price 3s.)—Should be a useful book, but as it is written for American readers there is much that is not applicable in English practice, and is therefore apt to confuse instead of enlighten. There are, however, many hints and directions which are universally applicable.

Introductory Mathematics. By R. B. Morgan. (Blackie & Son, Limited; price 2s.)—"This little book is an attempt to include in one cover all the Algebra, Geometry, and Graphs a boy ought to know before he can really be said to have done more than obtain an introduction to Mathematics." Such is the estimate of mathematical knowledge formulated in the preface. It would be more correct to say that a boy must grow up, and go to a university, and take a degree in mathematical honours before he can be said to have done so much as obtain an introduction to mathematics—unless that boy happened to be "made in Germany," when he would be initiated into what mathematics means a good deal earlier. But apart from the question as to what mathematics really is, the book appears to be a useful one. It consists mainly of easy exercises in the rules of algebra, slotting on squared paper and ruler and compass work. It thus embodies recent methods of teaching in a book of somewhat more elementary character than the majority. A few things might be improved, thus, after giving a rule for the area of a right-angled triangle, the author gives exercises in which the areas of figures made up of right-angled triangles are found, not by the rule but by the rough and ready method of counting squares. But in his examples the rule does not appear to be applied correctly, several broken squares being omitted that ought to be counted, and many counted that ought to be omitted. The results are not necessarily correct to the degree of approximation postulated in requiring boys to waste time in sharpening hard pencils to chisel-points. This last requirement (for which the author is in no way responsible) is calculated to lead to mischievous results later on, when boys ought to learn that the best drawn figure is only approximate, and that verifications by geometrical construction are not the same as proofs. But it must be claimed that the book puts a boy in the right way of getting a knowledge of what a great many people call mathematics, and what it is important for everybody to know.

Wellcome's Photographic Exposure Record and Diary. (Burroughs Wellcome and Co., London; price 1s.)—To the many who know this note book and diary it is only necessary to say that the volume for this year retains all its well-known features, while it is brought quite up-to-date in such tables as those of plate speeds, and has an improvement or two that add to the convenience with which it can be used. To any who have not seen it, we may say that it is a pocket diary of convenient dimensions and thin, one page to a week, with other blank pages for memoranda, and ruled pages for the record of as many negatives and prints as any photographer other than a trade worker or professional portraitist is likely to need, besides a great deal of letterpress information and an ingenious exposure calculator. The general information of the ordinary kind is compactly arranged, and the special information gives such details as photographers are most likely to need, including a system of judging the exposure necessary for making a negative under almost all conceivable conditions. The details of other photographic operations are given in terms of the firm's well-known "tabloid" preparations, but the directions are free from even the slightest evidence of a desire to advise the use of chemicals when they are not wanted. A photographer who needs elementary advice, or anyone who wants to develop and print away from home, may be assured that he will find sufficient information here.

Nature in Eastern Norfolk, by Arthur H. Patterson. (London: Methuen and Co., 1905.)—Throughout the length and breadth of the land the haunts of our native birds are being steadily and swiftly encroached upon. Game preserving, drainage, and the builder have done, and are doing, a deadly work, and those of us who find delight in the wild-places of nature are left lamenting. Time was, when Norfolk was a veritable Avian Paradise. To-day, we turn sorrowfully to the remnant that is left us, wondering how long even these will succeed in holding their own. This being so, it is fortunate that in these evil times there should have arisen an observer like Mr. Patterson. With the zeal of the enthusiast he has gathered together a rich harvest of facts relating to the "good old days" from the lips of the grey-beards who passed their time amid these vanished and vanishing birds and their haunts. Of these old men some have passed the "harbour bar" already, while the survivors are being coaxed by the author into making him the repository for their remembrance of happier days. How much they have to tell that is worth knowing those who have read Mr. Patterson's earlier book, reviewed in these columns a few months since, will probably remember with pleasure. The volume which he has just given us may be regarded as a supplement to this. And it is in every way a worthy supplement. It is this, and something more; for it is packed with most valuable field-notes of their author's own making: shrewd observation, tersely expressed, on birds, beasts and fishes. It is altogether a charming book, tastefully bound, and well illustrated.

W. P. P.

Eggs of British Birds, by W. J. Gordon. (London: Simpkin, Marshall and Co.)—It is impossible to say anything favourable of this book. The coloured plates are crude; the writing is slipshod, while the list of "British Birds, Past and Present," seems designed rather to fill up space than to serve any useful purpose. But worse than all, purchasers will find that "particulars as to the measurement, colour, and occurrence of the eggs" will be found in another book !!! W. P. P.

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More Natural History Essays, by Graham Renshaw, M.B., F.Z.S. (London: Sherratt and Hughes, 1905.)—The author presents us in this volume with a series of extremely interesting essays on some of the more remarkable mammalian types. Herein will be found much valuable information culled from old and long-forgotten records, as well as a few things that are new, at any rate, to the non-professional zoologist. Mr. Renshaw writes with an easy grace that lends an additional charm to all that he has to say. Tastefully bound, and well illustrated, this is a book that should find many friends. We note some omissions, however, the most important, perhaps, being the absence of all reference to Mr. F. A. Lucas's valuable summary on the extinction of Steller's Sea Cow (*Rhytina Stelleri*); as well as the investigations of Dr. Stejneger on the same subject. W. P. P.

A Glossary of Botanic Terms, with their Derivation and Accent, by B. D. Jackson. (Revised edition, 7s.6d. net, 8vo. pp. 371; Duckworth and Co.)—In the first edition of the work under consideration, the author commences with a quotation from Dr. Johnson, "Every other author may aspire to praise, the lexicographer can only hope to escape reproach." The early demand for a second edition should convince the author that he has escaped reproach; in addition, it may be stated that he merits praise for the production of a book of reference indispensable to everyone interested in the study of botany from any standpoint. In compiling a Glossary, discrimination cannot be exercised to the same extent as in other cases, hence out of the 16,000 terms defined in the second edition, the same organ is sometimes met with under different names. This condition of things is to a great extent the outcome of personal vanity or self-assurance. An author dealing with a structure already indicated by a recognized term, too frequently considers it necessary to coin a new one, often for reasons only apparent to himself. Nevertheless, such new terms must be duly chronicled in a Glossary. Oecology, or the study of plant life in relation to environment, a somewhat new phase of botanical investigation, has necessitated a considerable number of new terms which are here for the first time included in a Glossary of botanical terms. The author, however, felt compelled to draw the line at such compounds as "Carex-Sieversia-Polygonum-coryphium," in the vulgate "The Sedge-smartweed Alpine meadow formation." This is an American production; it might have been German. As most such compounds have been coined by one person, a reference to the work where they occur is given. There are no illustrations, hence the leaves consist of paper, and the book is light and pleasant to use. The type is excellent, and the key-words are not indented, but readily catch the eye.

Creatures of the Night, by A. W. Rees. (London: John Murray, pp. xix. + 448, illustrated; price 6s. net.)—If only the author had avoided the senseless and irritating habit of designating animals by such titles as "Vulp the Fox" and "Brock the Badger" (he might just as well say "Badger the Brock"!), he would have succeeded in producing a charming book. As it is, these names get on our nerves; but we may hope that they will not have the same effect on other readers. Mr. Rees is a keen observer of Nature and a thorough lover of animals; making little ado about sitting up half the night to watch a badger peer forth from its earth, or an otter steal out of its holt. To many of us such vigils would be deadly wearisome; and naturalists therefore owe a debt of gratitude to the author, for if we are to arrive at a thorough knowledge of the habits of animals, it is essential that the creatures should be thus carefully watched in their native haunts. British mammals of nocturnal habits form the main subject of the book, the otter, badger, fox, hare, hedgehog, and water and field voles (why does not the author call them by their proper country names—rats and mice?) forming the chief items; and in each case the life-history is charmingly written. Owls, nightjars, &c., are taken into consideration in the last chapter. In referring on page 441 to the object of the dark and light stripes on a badger's face, the author writes as though he were recording a new fact, which is not the case. The articles originally appeared in the *Standard*; but the re-publication in their present altered and expanded form is a distinct gain to natural history.

The Source of the Blue Nile, by A. J. Hayes. (London: Smith, Elder and Co., pp. xi. + 315.)—This work is in the main a record of the journey of a small expedition dispatched by the Egyptian Government to Lake Tsana, in Western Abyssinia, to which the author was attached as medical officer; the outward journey being by way of the Sudan, while the return route was to Egypt along the Atbara valley. Western Abyssinia is a country but little known to Europeans, and the author and his party traversed one district where white men had apparently never previously been seen. Western Abyssinia, as is pointed out in the preface, dominates the adjacent districts of the Sudan, and the importance to Great Britain of the continuance of good relations with the Ethiopian Empire is therefore self-evident. In addition to the narration of the journey, the book contains a number of observations on the religion, customs, &c., of the Abyssinians; and antiquarians should be much interested in a photograph of early paintings in the church at Bahardar Georgis. From the limited amount of available carriage, natural history collecting could be carried out only to a small extent, but Dr. Hayes was enabled to bring back a series of insects, which Professor Poulton describes in an appendix as being valuable and interesting from a distributional point of view. A few specimens of larger animals obtained by the author are shown in reproductions from photographs, among these being the "head of a hartebeest." This is a somewhat vague term, and the author might surely have found a naturalist friend to tell him that the specimen belongs to the tiang (*Damaliscus corrigum tiang*), an antelope which can only be called by courtesy a hartebeest, of which group it is a very aberrant representative. To all interested in adventurous travelling and the opening-up of Africa, Dr. Hayes's volume may be cordially commended.

Magnetism and Electricity for Students. H. E. Hadley. (Macmillan and Co., 6s.)—The scope of this volume is, roughly, that required to pass candidates for the B.Sc. examination of the University of London, and by students working for stages II. and III. of the Board of Education examination. The author has succeeded in compressing a very large amount of instructive information into its 575 pages; this information is conveyed wherever possible with the help of most excellent diagrams. There are a large variety of questions set at the end of each chapter which are selected, in the main, from examination papers. These will prove very useful, but their utility would be increased, especially to the private student, if answers were provided to more of them. The subject matter is, as a rule, very correctly presented. Some slips, such as fig. 51, ought to be rectified. This diagram gives an entirely misleading notion of the forces between an iron filing and a magnet. Diagram 54 on the following page indicates lines of force entering and leaving an iron ring (such as a Gramme-ring) much as though the flux was carried on by its own momentum. Teachers are exceedingly slow in learning that if the line reaches the iron surface even *slightly* inclined to the normal, then on the inside of the surface it is very nearly at right angles to its previous direction; that is, it is suddenly rotated through nearly a right angle. This action is a consequence of the high permeability of iron. In spite of these and certain other inaccuracies and deficiencies we can recommend the book as giving in general a simple and satisfactory account of its subject.

Circulating Scientific Library.—Mr. H. K. Lewis, 136, Gower Street, W.C., has sent us a copy of Nos. 23 and 24 of his "Quarterly List" of additions to the circulating library. The lists contain nearly 300 titles, and include many important new books and new editions on the various subjects covered by the library. There are brief notes to most of the books which, while not pretending to give the subscriber an exact idea of the book, enable an opinion to be formed on its general scope. The library has been long known as a useful medium for the supply of medical literature, and its extension to cover all branches of general science, commenced some two or three years ago, should add considerably to its value. We understand this neatly printed and useful "Quarterly List" will be sent post free regularly to anyone desiring to have it, and should think it would prove of service to all our readers who desire to keep themselves abreast of the important additions to scientific literature.

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NOTES.

ASTRONOMICAL.

By CHARLES P. BUTLER, A.R.C.Sc. (Lond.), F.R.P.S.

Seasonal Changes on the Moon's Surface.

PROFESSOR W. H. PICKERING has several times suggested that he has obtained photographic evidence of real changes on the lunar surface, and he has recently stated that there will shortly occur a favourable opportunity for critical examination of one of these supposed variable features. This is in connection with the small crater Linné, and the special observations can only be properly made at the time of a lunar eclipse, so that this may be done on February 8 next.

While several observers have proved that the size of the white area surrounding Linné is dependent on the time that the sun has been shining on it, or, in other words, on the co-longitude of the sun as seen from the moon, only four, Douglass, Saunder, Wirtz and Pickering have been able to observe it at the time of a total eclipse. The observers in question all agree that the white spot appears larger after emerging from the Earth's shadow than it did before it entered it. Hence it is very desirable that not only should the number of observations be increased, but definite measures of the extent of enlargement might be obtained if systematic arrangements are made.

The observation depending on the age of the moon may be made without great difficulty by comparing a pair of good lunar photographs, one taken soon after first quarter, the other near full moon, when the difference may amount to 2″ or 3″. In general the higher the sun the smaller is the spot. The observation during total eclipse is not so simple. An attempt was made during the last eclipse visible in America, in October, 1902, but failed owing to lack of co-operation. If observations can be secured this year, it is recommended that for an hour or so, both before and after the shadow transits Linné, as many micrometer measures as possible should be taken, all approximately in a north and south direction, as measures in this position angle are more accurate than others on account of the moon's orbital motion. Owing to the haziness of the edge of the white spot surrounding the crater, it would be advisable to start observations on a previous night to become familiarised with the region.

Rather conspicuous changes also occur in the white spots near the centre of Eratosthenes during the course of a lunation, and observers not possessing micrometers might endeavour to detect changes by comparison with neighbouring features of more constant dimensions.

Periodical Comets due in 1906.

Notice is given by Mr. W. T. Lynn of the expected return of two periodical comets during the present year.

Comet Holmes, which it is hoped we shall see during the spring months, was discovered at Islington on November 6, 1892, in Andromeda, and was first thought to be connected with the lost Biela's comet, but this was disproved when its motion was determined. It appeared strange that the comet was not seen about the time of its perihelion passage during August, 1892, and it has been supposed that a subsequent increase of intrinsic brightness may have taken place. The comet is remarkable for the small eccentricity of its orbit, which lies wholly between those of Mars and Jupiter; its *perihelion* distance from the sun is 2·2, and that of *aphelion* is 5·0. The period is about 6·8 years. It was seen on its second return by Professor Perrine on June 11, 1899, having passed perihelion on April 28. Another return to perihelion will therefore be due in the present year, and may possibly occur in the earlier months of the year.

Finlay's Comet, discovered at the Cape of Good Hope on September 26, 1886, passed perihelion on November 22 of the same year, and with a period of about 6½ years, was next seen in 1893 by Mr. Finlay again on May 17, which would be about a month before the calculated time of perihelion on June 16. At the return in the winter of 1899 the comet was unfavourably placed and escaped observation, and is due during the summer months of 1906.

Giacobini's Comet, 1905 (c).

This comet has been frequently seen on the Continent, but the unfavourable weather appears to have prevented many observations in England, as it could only be seen some little time before sunrise. Herr Strömgren has computed the following elementa:—

T = 1906 Jan. 22·63 G.M.T.
ω = 198° 22′
Ω = 91° 55′
ι = 43° 37′
q = 0·2238

The following ephemeris will serve as a guide in searching for the comet:—

1906.	R.A.			Declination.				Comparative Brightness.
	H.	M.	S.		°	′		
Feb. 2	23	50	16	−	8	4	S	20
6	0	33	34	−	1	40	S	14
10	1	11	28	+	4	2	N	10
14	1	42	48		8	48		7
18	2	9	56		12	38		4
22	2	32	56		15	40		3
26	2	52	52	+	18	6	N	2

Recent Meteorological Determinations by Kites.

Although systematic examination of the upper atmosphere is not yet carried out on this side with the completeness adopted in America, where it is chiefly due to the initiative of Professor Rotch, of the Blue Hill Observatory, we have constant evidence of the tendency to recognise the importance of this somewhat difficult branch of meteorological science.

At a recent meeting of the Royal Meteorological Society, Mr. G. C. Simpson described a series of attempts to fly kites for registration purposes from the deck of a mission ship (*Queen Alexandra*) attached to a deep-sea fishing fleet in the North Sea. The work was carried out during July and August, 1905, on behalf of the joint Kite Committee of the Royal Meteorological Society and the British Association. Eight ascents were successfully secured, and the greatest elevation recorded was 5800 feet.

Mr. C. J. P. Cave gave an account of his operations in Barbados, during April and May, 1905, and from an examination of the traces secured, Mr. W. H. Dines concludes that the humidity there varied from 60 per cent. at the surface of the ground, rising to 80-90 per cent. at heights from 1000-2000 feet, and then gradually falling off again to 50 per cent. or less as the elevation still further increases. It is noted that these values are lower than would have been expected in the region over a tropical ocean.

The increase is of the normal type, but the maximum value occurs at a far lower elevation than is the case in Europe. Extended observations having shown that it is probable that the relative humidity forms a reliable guide to the state of the vertical circulation, a low humidity indicating a descending current of air, it may be inferred from the above observations that there is a settling down of the atmosphere over the regions of the smaller West Indian Islands during April and May.

We believe that experiments are also in progress by the Indian Meteorological Department for exploring the upper atmosphere by means of automatic instruments attached to kites, and if successful it is expected to derive much practical information which should be extremely useful in increasing the accuracy of the weather forecasts so necessary to the welfare of the industries of the country.

Intrinsic Intensity of the Solar Corona.

Observing at Burgos on August 30, 1905, M. Charles Fabry determined the intrinsic intensity of various portions of

the coronal radiation during the Total Solar Eclipse. Using for comparison an Auer electric osmium lamp, the coronal image given by a lens of 1·20 metre focus was thrown on a plate carrying a diaphragm, so that any part of the corona could be examined at will and changes made quickly. The aperture of the objective could also be rapidly altered.

It was found that the intrinsic brightness of the corona at a point 5′ from the limb of the sun, in the direction of the equator, was about 720 candle power. That of the full moon was found to be 2600 of the same units, so that the intrinsic intensity of the coronal light at the point indicated was about 0·28 that of the lunar surface. This is in good accord with the previous determination by Turner in 1893, who, using a photographic method, obtained the value 0·25.

Comparing these values with the measured brightness of the sky close to the sun during ordinary times, it is found that the corona is probably about 2000 times less intense than the background of illuminated sky against which it is projected, and this indicates the difficulty to be contended with in any attempt to photograph or see the corona during ordinary sunlight. It is possible that certain exceptional stations at high altitudes, and with very dry climate, may offer the least discouraging conditions.

CHEMICAL.

By C. AINSWORTH MITCHELL, B.A. (Oxon.), F.I.C.

A Method of Rendering Phosphorus Harmless.

A NEW process of treating ordinary yellow phosphorus has been patented by M. Bals in France. The phosphorus is mixed while in a melted condition, or as it condenses from the vapour in its manufacture, with a salt which does not decompose when melted, *e.g.*, sodium thiosulphate ("hypo"). The process must be carried out in a vacuum or in an atmosphere of inert gas such as carbon dioxide, so as to prevent contact with the air, and it is also recommended to use a liquid such as petroleum oil or turpentine in addition to the salt so as to coat each fine particle of treated phosphorus with a protective layer of substance that will prevent oxidation. It is claimed that finely divided phosphorus thus treated can be transported and used in the manufacture of matches without risk of injury to the workman.

The Toxine of Eel's Blood.

A characteristic kind of poison is found in the blood serum of the eel, conger, and certain allied species. It is formed as a normal product during the life of the fish, and in this respect resembles the venom of snakes, which has been shown to be present in the blood as well as in the poison glands. The eel toxine was discovered in 1889 by M. Mosso, who found that it prevented the blood of poisoned animals from coagulating, and since then its physiological properties have been thoroughly studied, notably by Drs. Camus and Gley, and more recently by Dr. Wendelstadt. The serum as obtained from the eel has a slight yellowish-green colour, and retains its toxic power for some time if protected from the light. There is a great variation in the degree of toxicity of the sera from different eels, the season of the year being a factor of considerable importance. The toxine itself has not yet been isolated in even an impure condition, although it has been shown that it has the same general characteristics as all true toxines as defined by Ehrlich ("KNOWLEDGE AND SCIENTIFIC NEWS," this vol., p. 317). Thus it is destroyed by heat and by strong chemical agents, and can be obtained in solid form without injury by evaporating the serum in a vacuum. It acts upon the respiratory centre, which it paralyses, upon the heart, and upon the nervous system, the general effects being very similar to those produced by snake venoms. It has also an active solvent effect upon the corpuscles of the blood. It is said to resemble snake venom in being harmless when swallowed, although Dr. Pennevaria records an instance of a man being poisoned after eating eel's blood. The probable explanation is that in that case there was some abrasion of the mucous membrane of the mouth or stomach, by means of which the toxine could gain access to the blood. Dogs are extremely sensitive to the action of the poison, whilst the hedgehog is almost completely refractory. As is the case with all true toxines, it is possible to produce an anti-toxine in the blood serum of susceptible animals, and thus to render them immune against enormous doses of the venom. Rabbits and goats are easily immunised, but it is very difficult to produce immunity in guinea-pigs.

The So-Called Gold-Coated Teeth in Sheep.

Mr. A. Liversidge has investigated the nature of the "gold" which has frequently been reported to have been found on the teeth of sheep. The teeth of the lower jaw bone of a sheep examined by him were encrusted with a yellow substance, resembling iron pyrites, the thickness of the deposit being less than $\frac{1}{32}$ of an inch. The incrustation was brittle, and could be removed in scales, leaving a black surface. When examined under the microscope the scales were seen to consist of thin translucent pale brown layers, but did not show any organic structure. They were partially soluble in dilute hydrochloric acid, and when heated turned black, leaving a residue consisting chiefly of calcium phosphate. The incrustation thus appears to be a deposit of tartar, accompanied possibly by slight decay of the surface of the tooth, and the metallic lustre is to be attributed to the reflection of light from the different surfaces of the films of the substance.

Natural Gas in Western Australia.

Prior to last year fire-damp was unknown in the mines of Western Australia, and it then appeared, not in a coal mine, but in a Kalgoorlie gold mine. In drilling a borehole there was, at a depth of 687 feet, a rush of gas which took fire on contact with a candle, and was not easily extinguished. The emission of gas continued for a month and then ceased, safety lamps being meanwhile used in the mine. Samples of this gas have been examined by Mr. E. Mann, the Government Analyst, and found to consist, in the main, of marsh gas (methane) and nitrogen, with from 5 to 8 per cent. of oxygen and less than 0·5 per cent. of carbon dioxide. It is suggested that there may be some connection between the occurrence of the gas and the presence of a band of graphite schist in the geological formation.

Radio-thorium: A New Element.

Sir William Ramsay has added yet another element to the long list of those already discovered by him. Radio-thorium, as this new element is termed, was isolated from the radio-active mineral, thorianite, from Ceylon ("KNOWLEDGE AND SCIENTIFIC NEWS," 1905, p. 228). It is very similar to the rare earth metals, and is distinguished from thorium by forming a soluble sulphate, and from radium by the solubility of its oxalate in ammonium oxalate solution. Its radio-activity is 500,000 greater than that of thorium. Sir William concludes that the helium found in thorianite is derived from radio-thorium, and suggests the following scheme as illustrative of the relationship: Inactive thorium —> radio-thorium —> thorium X —> emanation —> thorium A —> thorium B —> ? —> helium.

GEOLOGICAL.

By EDWARD A. MARTIN, F.G.S.

Carboniferous Rocks at Rush.

LEAVING for the time being his researches into the geology of Anglesea, Dr. C. A. Matley has turned his attention to the "Carboniferous Rocks at Rush (co. Dublin)," and has laid the results gained before the Geological Society. Dr. A. Vaughan has in the same connection dealt with the "Faunal succession and correlation of the rocks," which extend for a distance of five miles along the coast near Rush. The southern portion of the tract consists of an exposure of about 2500 feet, the range being from the upper *Zaphrentis* to the upper *Dibunophyllum* zones. The Rush Slates are the lowest beds, and are 1380 feet thick, the characteristic fossil being *Zaphrentis* aff. *Phillipsi*. Above these is the Rush conglomerate group, 500 feet thick. In these conglomerates are found Osdovician and Silurian rock-fragments, together with many inclusions of carboniferous limestone. Above the conglomerates are some

beds, mainly limestones and calcareous shales, which have been thrown into numerous sharp folds and are occasionally inverted. The highest beds seen were the *Cyathaxonia* beds, correlated with the Oystermouth Limestone of the South-West Province. Dr. Matley proposes to continue his investigations into the northern portion of this interesting series.

Rocks of the Ludlow District.

There are few women geologists of front rank, and for the matter of that, there are unfortunately but few women geologists at all. The times move on, however, in this respect as in other fields of labour, and, to their credit be it said, the Fellows of the Geological Society raised no objection to the presence of ladies at their meeting at Burlington House, when Miss Gertrude L. Elles, D.Sc., read a joint paper by Miss I. L. Slater and herself, on "The Highest Rocks of the Ludlow District." Unfortunately every new worker on any given set of rocks thinks it well nowadays either to adopt a new classification or to introduce new names to old rocks. Granted that this may be advisable, or even necessary, on occasion, but there should be great hesitation in doing so, except under sheer necessity, whilst even in such case experience shows that new classifications of rocks seldom become generally accepted. In the paper in question, the authoresses give the following classification :—

	Feet.	
III. TEMESIDE GROUP.	110 to 120	Zone of *Lingula cornea* and *Eurypterus*.
	30 to 50	Zone of *Lingula minima*.
II. UPPER LUDLOW GROUP.	150 to 160	Zone of *Chonetes striatella*.
	110 to 120	Zone of *Rhynchonella nucula*.
I. AYMESTRY GROUP.	40 to 150	Zone of *Dayia navicula*.
	75 to 250	Zone of *Conchidium Knighti*.
	515 to 850	

A mass of most interesting and technical information is given in the paper, and the remark is made that the main tectonic features of the district appear to be due to the superposition of Armorican movements in rocks with a Caledonian trend, held by some rigid mass to the north, presumably the Longmynd massif.

Water Supply.

The cry for new water supplies to satisfy our ever-increasing town populations is heard now in one direction and now in another. Near London there are so many draughts made upon the chalk both for private and public supplies, that the water-level is steadily diminishing, besides which there is the fact, not yet satisfactorily explained, that while one deep boring will yield a bountiful supply another a mile away results in disappointment. Croydon has been fortunate hitherto in sources of supplies at her very doors, but in order to allow for the necessities of a further increase of her present population of 150,000 persons, the local authorities are anticipating an expenditure during the next ten years of nearly a quarter of a million, in order to tap fresh sources of supply. To do this, it will be necessary at length to go outside the borough borders, special stress being paid in the selection of a site as to whether or no the chalk is covered by a sufficient depth of tertiaries to form a suitable filtering medium. It is a matter of opinion as to what quantity of the water obtained actually passes through the overlying deposits, and when those fertile fissures are struck, which water-borers eagerly anticipate, the probabilities are that a very small quantity of the water thus gained ever passes through the covering at all.

The Yorkshire Cliffs.

"The Making of East Yorkshire" is a chapter in local geography to which Mr. T. Sheppard, F.G.S., has given his attention, and his booklet on the subject which has reached us is an interesting and popular description of the Yorkshire cliffs, and the coast to Spurn Head, where there are no cliffs to speak of at all. Amongst other remarks, he gives us some idea of the loss of land by erosion by his estimate of the loss of 7 feet per annum throughout a length of 30 miles. Much of the denuded material is helping to extend Spurn Head in a south-westerly direction.

"Scree" below Snowdon.

Our illustration gives an idea of the scree formed by tumbling of Silurian blocks down the Capel Curig side of Snowdon. It is a subject for consideration when first the

"Scree" below Snowdon.

scree was formed, whether there is any movement in it now, and if so, at what rate the movement is proceeding.

[The Geological Editor would be glad if readers will bear in mind that he is always glad to receive geological and kindred notes for publication, and also copies of papers read before local societies. They can be sent to him, c/o KNOWLEDGE, or to his address at 58, Whitworth Road, South Norwood, S.E.]

ORNITHOLOGICAL.

By W. P. PYCRAFT, A.L.S., F.Z.S., M.B.O.U., &c.

The Kea Parrot and Sheep Slaughter.

WE have always felt that if there were any truth at all in the stories of the depredations caused by the Kea Parrot (*Nestor notabilis*) on New Zealand sheep farms, they must be greatly exaggerated.

In the Field (Dec. 30), "R. L." gives a brief account of the results of a conference of representative men held recently in Wellington. It would seem that they have been enabled to show that these stories are without foundation in fact. "All the members of this conference were men well acquainted with this bird in its native haunts, but not one of them, either as the result of his own experience, or from the testimony of others, was able to adduce a single item of evidence in support of the alleged sheep-worrying charge."

It is well that this exoneration comes now. For years these birds have suffered a grievous persecution, so much so that they are on the verge of extermination. Whether of the remnant that is left enough remain to restock the depleted areas time alone will show.

The Protection of Small Birds.

We are glad to note that the German Board of Agricultural Biology and Forestry has taken up the question of the protection of birds useful to agriculturists. Mr. Dunnington Jefferson, in the *Field* (Jan. 13), gives a short account of the efforts that are being made to this end, though we cannot but feel that some mistake has been made concerning his account of the endeavours which are being made by way of tempting insectivorous birds to breed. Not only have nesting-boxes

been put up, but according to the authors nests have been supplied to save the birds the trouble of building. "The Department," he says, "has undertaken the supply of artificial nests suitable for the different species . . . for swallows, moss or a few dead leaves are provided"! Either the translator has misread some portion of the original account of this work, or the well-meaning authors of these nests have not so wide a knowledge of field ornithology as we should expect. Be this as it may, the provision of nest-boxes, and the efforts to encourage these birds, is a step in the right direction. In this country the question of the protection of birds is a cause of much difference of opinion; and we shall never arrive at any satisfactory solution of the problem until the matter is taken up by the Board of Agriculture as is done in Germany and America.

Lesser Grey Shrike at Chichester.

At the last meeting of the British Ornithologists' Club (Dec., 1905), Mr. A. F. Griffith exhibited a specimen, in autumn plumage, of the Lesser Grey Shrike (*Lanius minor*), which had been killed near Chichester in October, 1905.

Little Shearwater at Lydd.

At the meeting above referred to a male example of the little dusky Shearwater (*Puffinus assimilis*), which had been captured at Lydd, in Kent, was exhibited on behalf of Dr. N. F. Ticehurst. This bird, which marks the fourth occurrence of this species in Britain, was taken alive after the south-west gale of Nov. 26.

Breeding Place of Ross's Gull.

Mr. H. E. Dresser at this same meeting announced the fact that a breeding place of Ross's Gull (*Rhodostethia rossi*) had been recently found in the Kolyma delta, North-East Siberia. Mr. Buterlin, a Russian naturalist, the fortunate discoverer, procured an adult bird, young in down, and eggs.

PHYSICAL.

BY ALFRED W. PORTER, B.Sc.

Instrument for Compounding Vibrations.

THE following means of compounding several harmonic motions, all taking place parallel to one straight line, is described by Lord Rayleigh in the *Philosophical Magazine* for January.

"A wooden batten, say 1 inch square and 5 feet long, is so mounted horizontally as to be capable of movement only along its length. For this purpose it suffices to connect two points near the two ends, *each* by means of *two* thin metallic wires with four points symmetrically situated in the roof overhead. . . . The movement of the batten along its length is controlled by a piece of spring-steel against which the pointed extremity of the batten is held by rubber bands. Any force acting in the direction of the length of the batten produces a displacement proportional to the force. The tracing point by which the movements are recorded is at the other end, as nearly as possible in the line joining the two points of attachment of the four suspending wires. The longitudinal forces are due to the vibrations of pendulums hanging from horizontal cross pieces attached to the batten at their centres. The two ends of a wire or cord are attached to the extremities of a cross piece, the bob of the pendulum being a mass of lead (perhaps half a pound) at the middle of the cord. When set swinging the movements of the pendulums are thus parallel to the batten, and tend to displace it along its length." The smoked paper or glass upon which the style leaves a trace must, of course, be given in addition a uniform motion either by drawing it along a guide, or by rotating it in its own plane like the face plate of a lathe. If done in the latter way excellent lantern slides may afterwards be made by photography showing the resultant effect of combining simple harmonic motions in the way described. If it be required to make the component vibrations have periods in simple proportion to one another, it must be remembered that the period of a pendulum is proportional to the square root of its length (*i.e.*, in this case the distance of the centre of the bob to the centre of the line joining the ends of its suspending wires). For example, the effect of combining a note and its octave (which has half the period of the note) can be illustrated by having two pendulums only, whose lengths are, say, 4 feet and 1 foot.

Active Deposit from Radium.

Dr. H. L. Bronson shows (1) that temperatures between 700° and 1100° C. do not permanently affect the rate of decay of the active deposit from radium; (2) That radium B and not radium C has the longer decay period; (3) That the previous values of twenty-eight and twenty-one minutes are both too large for the decay periods of radium B and C respectively; and that twenty-six and nineteen minutes are much closer to the true values.

ZOOLOGICAL.

BY R. LYDEKKER.

Regeneration in Mammals.

AT the December meeting of the Zoological Society was exhibited the skeleton of the tail of a dormouse showing distinct evidence of reparation after an accident; this being apparently the first recorded instance of the regeneration of bony structure in mammals. The re-formed vertebra, which had assumed the form of a slender rod, was composed externally of true bone, whereas in the regenerated tails of lizards the new structure consists of calcified fibro-cartilage.

Spicules of Sponges.

A remarkable instance of diversity of view is exemplified by two explanations which have recently been offered of the function of the triradiate mineral spicules found in many sponges. A writer in the November issue of the *American Naturalist* tells that these structures at first merely took the form of small spiny developments in the flesh in order to prevent sponges from being eaten by other creatures. As time went on these spicules were carried to the perfection of symmetrical development by what the author is pleased to call "momentum," that is to say, the continuance of development along a particular line long after any useful result accrues to the animal in which such evolution takes place. By a curious coincidence, in the *Quarterly Journal of Microscopical Science* for the very same month, an English naturalist points out that these triradiate spicules are probably a special adaptation to prevent the stems of slender sponges from being broken by the action of the waves of the shallow water in which they grow; the triradiate form affording protection in three different planes. The moral of this is, Never affirm a structure to be useless unless you are absolutely sure there is no possible purpose it can serve.

Fossil Flying-fishes.

Fossil flying-fishes form the subject of an interesting and well-illustrated communication by Dr. O. Abel to the Year-Book of the Austrian Geological Survey. At the present day there are two distinct types of flying-fishes, namely, the flying-gurnards and the flying-herrings, the latter being what may be called the typical flying-fishes; and it is quite evident that each of these has acquired its powers of flight quite independently of the other. Similarly, Dr. Abel shows that in past geological times several kinds of fishes, totally distinct from the modern types, possessed long pectoral fins, which were intended, in all probability, to enable their owners to skim the surface of the water in flying-fish fashion. The earlier of these fishes—*Thoracopterus* and *Gigantopterus*—occur in strata belonging to the period of the Trias, or New Red Sandstone, and, like their non-flying contemporaries, had their bodies encased in an armour of quadrangular enamel-covered scales.

Papers Read.

At the meeting of the Zoological Society held on December 12, Mr. H. R. Hogg read a paper on South African spiders of the family *Lycosidæ*; Mr. O. Thomas discussed mammals collected in Persia, describing a new genus and species of hamster-like rodent allied to the North America *Peromyscus*; colour-variation in a beetle formed the subject of a communication by Mr. L. Doncaster; the Society's Prosecter discoursed on new worms; Dr. de Man described a crab and a prawn from Christmas Island; the heredity of webbed feet in pigeons was discussed by Mr. R. S. Browne; while Messrs. Warburton and Pearce gave an account of new and rare British *Oribatidæ*.

XUM

MICROSCOPY

Conducted by F. SHILLINGTON SCALES, B.A., F.R.M.S.

Elementary Photo-micrography.

(*Continued from page* 336.)

THE axis of the microscope should point straight down the camera baseboard towards the light, parallel with the sides; it must be truly horizontal and the disc of light should appear exactly in the centre of the ground-glass screen. Now remove the objective and the ground-glass screen and look straight along the tube, and then adjust the illuminant until it appears in the centre of the limited field of view. Next move the camera up in its slides until there is room for the head to be placed between it and the microscope in order to enable the eye to look down the tube. It is a convenience in this respect if the whole portion of the camera base which carries the microscope, lamp, &c., rotates on a pivot to one side.

We have now got the microscope in the place it will occupy in photographing, and we have also got the source of illumination approximately centred, but have still to centre the sub-stage and auxiliary condensers. First centre the sub-stage condenser. This is done in the usual way by using an ordinary eye-piece and a fairly low-power objective, say one inch, closing the iris-diaphragm as much as possible, and racking the body-tube up or the condenser down until the edges of the diaphragm appear in the field, so that the small central disc of light can be centred with the centring screws. Then focus the objective upon some suitable slide placed upon the stage and focus the condenser. If the image of the illuminant does not appear in the centre of the field it must be brought there by moving the illuminant laterally and not the condenser. This is sometimes rather a troublesome job as very small adjustments are required, and the hands cannot reach the light whilst the eye is at the microscope tube, so that assistance from a second person is of service. The auxiliary condenser now alone remains to be centred, and this can only be done by means of a cap of brass or blackened cardboard fitting on its anterior face, and perforated with a very small hole. This small hole is focussed by means of the sub-stage condenser, but it is brought central by moving the auxiliary condenser vertically or horizontally, and again not by re-centring the sub-stage condenser. Care must be taken that the auxiliary condenser is set true and square with the long optic axis, to which we have so carefully adjusted everything. It must then be decided at what distance from the lamp the auxiliary condenser shall be placed, whether to give parallel or convergent light, and if the latter, where the light shall come to a focus. The experiments with the white paper will prove very useful here. The blackened disc is, of course, removed after the centring, just as the iris-diaphragm of the sub-stage condenser is re-opened. On examining the ground glass screen, a bright and uniformly illuminated disc should be observed in the centre of the screen. Of course, with a one-inch objective the sub-stage condenser will probably not give a big enough field of light, in this case the top lens can be removed.

(To be continued.)

Royal Microscopical Society.

December 20, at 20, Hanover Square, Dr. Dukinfield H. Scott, F.R.S., president, in the chair. The President called attention to a donation of slides prepared by Andrew Pritchard, about 50 years ago, presented to the Society by Mr. N. D. F. Pearce, which were exhibited under microscopes in the room. Mr. Rheinberg called attention to an exhibit consisting of about 20 photographs of diatoms, taken by the Zeiss apparatus designed by Dr. August Köhler, of Jena, for photo-micrography with ultra-violet light, having a wave-length of 275 $\mu\mu$ (see "KNOWLEDGE" for June, 1905, p. 138). The photographs were taken with a 1.7 m.m. monochromatic objective of 1.25 N.A., using light from the cadmium spark, and having a resolving power equivalent to a N.A. of 2.5, with an objective used with ordinary light, were such possible. There were photographs of *Surirella gemma*, and *Amphipleura pellucida*, one of the latter, taken with oblique illumination, showing the diatom clearly resolved into dots. Photographs of the same diatom taken with a 2 m.m. apochromatic objective of 1.4 N.A., and light from the magnesium spark ($\lambda=383$ $\mu\mu$), and at the same magnification, *i.e.*, 1800 diameters, were shown for comparision, and the difference was very apparent. Mr. Curties said that this was not the first time *A. pellucida* had been resolved into dots, for he remembered such a photograph being made by Mr. Gifford, whilst Dr. Spitta showed the diatom itself at one of the Society's meetings, but the resolution in these cases was less distinct than in the photographs now shown by Mr. Rheinberg. Mr. D. M. S. Watson read a paper on "A Fern fructification from the lower coal measures of Shore, Lancashire," and exhibited a large section of the coal under the microscope, also lantern slides to illustrate the paper. In the ensuing discussion, the President, Professor F. W. Oliver, and Mr. E. A. Newell Arber, took part.

Quekett Microscopical Club.

The 426th ordinary meeting was held at 20, Hanover Square, W., on December 15, the President, Dr. E. J. Spitta, F.R.A.S., F.R.M.S., in the chair.

Mr. Bryce read a description by Mr. J. Murray, of a new Bdelloid Rotifer, from Upper Sheringham, Norfolk, under the name of *Callidina vesicularis*. It somewhat resembles the well-known *C. quadricornifera*.

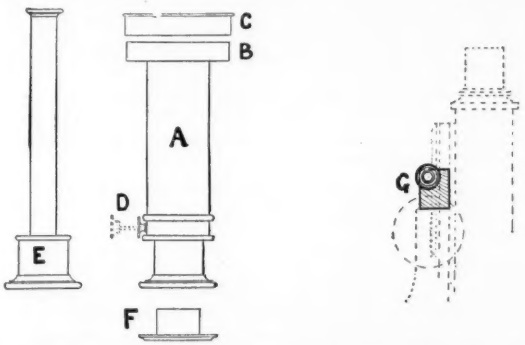
The President then delivered a paper on "Some Experiments relating to the Insect Compound Eye." After some preliminary remarks, he reminded his hearers of the general formation of the human eye, laying especial stress on the extremely delicate nature of the retina. Considering the insect compound eye, he said one of the chief differences to be noted was that, in the human eye the retina was separated from the cornea by a lens (not to mention two fluid media), while in the insect, the retina was in actual contact with the back of the cornea. He suggested that there was no real lens at all in the eye of most insects, and quoted the last edition of Dr. Packard's "Entomology" in support of his statement. He believed that the cornea might be considered as a series of small holes. The lecturer then reminded his audience how the multiple images of the so-called insect-eye were obtained in the microscope, and attention was drawn to the fact that, to make the experiment, only the cornea of the eye is used by the microscopist—the soft parts being usually washed away, or otherwise destroyed in the mounting. After referring to several of the difficulties met with by those who accepted the orthodox

theory on the subject, the President said that, in his opinion, all these difficulties, anatomical, physiological, and physical, might be swept away by regarding each facet as a little hole (possibly filled with a simple non-refracting material). After dealing with various points connected with this suggestion, the lecturer went on to describe an experiment he had made which seemed to support his contention very strongly. A photograph of a piece of perforated zinc was made, so very much reduced as to almost require a lens to see the holes. This little artificial cornea was then placed on a microscope stage and a very small cross marked on the mirror below. A slide then thrown on the screen at once displayed the multiple image effect produced by these artificial means.

A very interesting discussion followed the lecture.

Gordon's Apparatus for Photo-micrography.

Many microscopists must have often desired some simple form of photo-micrographic camera which could be readily applied to a microscope, with little re-adjustment, to obtain a photograph of some object which is being examined visually. Mr. J. W. Gordon has designed a small camera for this purpose, which, whilst not differing in principle from other cameras of the sort, such as that made by Mr. John Browning, contains several original and useful features. Briefly, the camera consists of a circular brass tube (A) about



six inches long, which is placed over the microscope eyepiece. At the upper end of the tube a small cap (B C) contains a photographic plate, in size one quarter of an ordinary lantern plate, *i.e.*, $1\frac{5}{8}$-inch square, giving circular pictures $1\frac{3}{8}$-inch in diameter. Between this and the eyepiece is a projection lens focussed upon the plate, and there is also a small exposing shutter (D). Such a camera can be kept close at hand during one's work, ready for use at any time. If the observer's sight is normal, the photograph will be sharp when the microscope is focussed for ordinary vision, but as most people have some slight abnormalities of vision, a duplicate tube (E), with a high-power focussing eyepiece, is supplied. This is first placed on the microscope, in order to focus, and then merely replaced by the camera. A small flange (F), fitted over the upper end of the microscope, forms a table upon which to rest the camera. It has been found that microscopes used in an upright position for photo-micrography, have a tendency to move slightly downwards, and to prevent this a small metal block (G) is provided, which fits above the coarse adjustment and clamps the tube in any position. The principle of this clamp is so simple that one wonders it has not been thought of before. It can be made to fit any microscope, and should be equally useful in preventing broken slides at microscopical exhibitions. The whole apparatus is noticeable for its extreme simplicity, ease of adjustment, and moderate price, whilst the two photographs reproduced herewith will show what

Tongue of Blowfly.

Pleurosigma Formosum.

the resulting photographs are like. I may add that these photographs were taken with a Welsbach gas lamp, and a yellow screen, with exposures varying from 20 to 60 seconds. The apparatus is made by Messrs. R. and J. Beck, Ltd.

Microscopic Slides.

Messrs. Clarke and Page, of 104-106, Leadenhall Street, E.C., have sent me four very beautiful slides of marine objects. The staining and mounting show the structures to unusual advantage, and the prices are moderate. Messrs. Clarke and Page bought the stock of Mr. Jas. Hornell, which was, of course, limited, and I understand that these slides are their own mounting to replace his stock. They have sent me, at the same time, a catalogue of mounted slides, and if those I have seen are representative, they have fully maintained the high standard set by Mr. Hornell.

Notes and Queries.

W. Birrell, Kilmarnock.—All slides mounted for examination by transmitted light, that is, all transparent slides, can be readily shown upon a screen by means of a projection microscope, and they will, of course, thus retain their proper colours, But, unfortunately, such a microscope is rather an expensive apparatus, as the ordinary microscope is not suitable. A lantern is needed with a powerful source of illumination; nothing weaker than the oxy-hydrogen light is any good, and at a distance of more than a very few yards from the screen the arc light becomes necessary. Even with this last powerful light the difficulties become serious with the higher magnifications given by immersion lenses, but the oxy-hydrogen light is quite satisfactory for moderate distances and moderate powers. Then special parallelisers and condensers are necessary to supplement the condenser of the lantern. The microscope itself does not differ materially in principle from an ordinary microscope except that its body-tube is necessarily very short. I am afraid, therefore, your most economical method would be to make lantern slides of the objects you wish to show. You could, however, of course content yourself with borrowing as many microscopes and lamps as possible, and showing the slides after the reading of your paper. This is commonly done at meetings. Hand-microscopes, which can be handed round, are far from satisfactory.

S. P. Mummery, London, and *E. J. Adderley, Hull.*—I regret that owing to pressure on my space answers to your queries must be held over for another month.

[*Communications and Enquiries on Microscopical matters should be addressed to F. Shillington Scales, "Jersey," St. Barnabas Road, Cambridge.*]

The Face of the Sky for February.

By W. SHACKLETON, F.R.A.S.

THE SUN.—On the 1st the Sun rises at 7.42 and sets at 4.46; on the 28th he rises at 6.51 and sets at 5.35.

Solar activity is well maintained, and on almost any day spots and prominences may be observed.

The position of the Sun's axis and equator is shown in the following table :—

Date.	Axis inclined from N. point.	Centre of disc S. of Sun's Equator.
Feb. 1	12° 0′ W	6° 7′
,, 11	15° 55′ W	6° 43′
,, 21	19° 17′ W	7° 5′
,, 28	21° 16′ W	7° 13′

There is a partial eclipse of the Sun on the 23rd, invisible in this country, but visible in the Antarctic and S. Australia.

THE MOON :—

Date.	Phases.	H. M.
Feb. 1 ..	☽ First Quarter	0 31 p.m.
,, 9 ..	○ Full Moon	7 46 a.m.
,, 16 ..	☾ Last Quarter	4 23 a.m.
,, 23 ..	● New Moon	7 57 a.m.
,, 1 ..	Apogee	1 6 p.m.
,, 13 ..	Perigee	10 12 p.m.

There is a total eclipse of the Moon on the 9th, but it takes place in the early morning shortly before sunrise, and is only partly visible in this country, the Moon setting totally eclipsed. The particulars are as follows :—

	h. m.
First Contact with Shadow, Feb. 9,	5.57 a.m.
Beginning of Totality, ,, ,,	6.58 ,,
End of Totality, ,, ,,	8.36 ,,
Moon Sets, ,, ,,	7.30 ,,

Magnitude of eclipse (Moon's diameter = 1) 1·632.

OCCULTATIONS :—

Date.	Star's Name.	Mag.	Disappearance. Mean Time.	Disappearance. Angle from N. point.	Reappearance. Mean Time.	Reappearance. Angle from N point.	Moon's Age.
			p.m.		p.m.		d. h.
Feb. 3	**Aldebaran**..	1·1	5.23	40°	6.28	287°	10 1
,, 4	115 Tauri	5·4	5.25	103°	6.33	232°	11 1
,, 4	120 Tauri	5·3	9.54	18°	10.26	331°	11 5
,, 7	ζ Cancri	4·7	7.7	60°	8.4	308°	14 2
					a.m.		
,, 10	χ Leonis	4·7	11.7	134°	12.12	269°	17 6
					p.m.		
,, 28	μ Ceti	4·4	7.0	54°	8.9	271°	5 11

THE PLANETS.—Mercury (Feb. 1, R.A. $20^h\ 4^m$; Dec. S. 22° 3′. Feb. 28, R.A. $23^h\ 9^m$; Dec. S. 6° 48′). The planet is in conjunction with the Sun on the 20th, and is practically unobservable throughout the month.

Venus (Feb. 1, R.A. $20^h\ 45^m$; Dec. S. 19° 10′. Feb. 28, R.A. $22^h\ 57^m$; Dec. S. 8° 13′) is in conjunction with the Sun on the 14th; towards the end of the month the planet is an evening star in Aquarius, but not well placed for observation.

Mars (Feb. 1, R.A. $23^h\ 51^m$; Dec. S. 1° 31′. Feb. 28, R.A. $1^h\ 5^m$; Dec. N. 6° 46′) may be observed, shining like a reddish star, in the evening sky looking S.W. The planet is situated in the constellation Pisces and sets about 9 p.m. throughout the month. On account of his small angular diameter he is not a very suitable object for observation in small telescopes.

Jupiter (Feb. 1, R.A. $3^h\ 38^m$; Dec. N. 18° 42′; Feb. 28, R.A. $3^h\ 47^m$; Dec. N. 19° 17′) is a very conspicuous object in the evening sky; near the middle of the month the planet is due south about 6 p.m., and is both well placed and easy of observation.

The equatorial diameter of the planet on the 13th is 40″·8, whilst the polar diameter is 2″·6 smaller.

The following table gives the satellite phenomena observable before midnight :—

Date.	Satellite.	Phenomenon.	P.M.'s. H. M.	Date.	Satellite.	Phenomenon.	P.M.'s H. M.	Date.	Satellite.	Phenomenon.	P.M.'s H. M.
Feb				Feb				Feb			
1	I.	Oc. D.	8 47	9	I.	Sh. E.	11 23	18	II.	Oc. D.	8 23
2	I.	Tr. I.	5 57		II.	Tr. I.	11 27		II.	Oc. R.	11 1
	I.	Sh. I.	7 15	10	I.	Ec. R.	8 40		II.	Ec. D.	11 4
	I.	Tr. E.	8 11	11	II.	Oc. R.	8 25	20	II.	Sh. E.	8 43
	II.	Tr. I.	8 52		II.	Ec. D.	8 28	22	III.	Oc. D.	7 54
	I.	Sh. E.	9 28		II.	Ec. R.	11 1		III.	Oc. R.	10 0
	II.	Tr. E.	11 29	13	II.	Sh. E.	6 5	23	I.	Tr. I.	11 41
	II.	Sh. I.	11 29	15	III.	Ec. D.	9 22	24	I.	Oc. D.	9 1
3	I.	Ec. R.	6 44		III.	Ec. R.	11 13	25	I.	Sh. I.	7 29
4	II.	Ec. R.	8 24	16	I.	Tr. I.	9 45		I.	Tr. E.	8 24
	III.	Tr. I.	10 6		I.	Sh. I.	11 5		I.	Sh. E.	9 43
8	III.	Ec. R.	7 11		I.	Tr. E.	11 59		II.	Oc. D.	11 0
	I.	Oc. D.	10 41	17	I.	Oc. D.	7 4	26	I.	Ec. R.	7 0
9	I.	Tr. I.	7 51		I.	Ec. R.	10 36	27	II.	Tr. E.	8 41
	I.	Sh. I.	9 10	18	I.	Tr. E.	6 28		II.	Sh. I.	8 43
	I.	Tr. E.	10 4		I.	Sh. E.	7 48		II.	Sh. E.	11 21

"Oc. D." denotes the disappearance of the Satellite behind the disc, and "Oc. R." its re-appearance; "Tr. I." the ingress of a transit across the disc, and "Tr. E." its egress; "Sh. I." the ingress of a transit of the shadow across the disc, and "Sh. E." its egress.

Saturn (Feb. 1, R.A. $22^h\ 21^m$; Dec. S. 11° 58′. Feb. 28, R.A. $22^h\ 33^m$; Dec. S. 10° 47′) is in conjunction with the Sun on the 24th, and practically unobservable throughout the month.

Uranus (Feb. 2, R.A. $18^h\ 29^m$; Dec. S. 23° 33′) is a morning star, rising about 5 a.m., near the middle of the month.

Neptune (Feb. 14, R.A. $6^h\ 34^m$; Dec. N. 22° 16′) is due south at 8·58 p.m. on the 14th. The planet is situated in Gemini, but is difficult to identify among the numerous small stars in the same field, when viewed in a 3-inch telescope.

METEOR SHOWERS :—

Date.	Radiant. R.A.	Radiant. Dec.	Near to	Characteristics.
Feb. 5–10 ..	75°	+41°	η Aurigæ	Slow; bright.
,, 15 ..	236°	+11°	α Serpentis	Swift; streaks.
,, 20 ..	181°	+34°	Cor Caroli	Swift; bright.

Algol may be observed at minimum on the 7th at 9.36 p.m., 10th at 6.25 p.m., and 27th at 11.18 p.m.

DOUBLE STARS.—*Castor*, separation 5″·8, mags. 2·7, 3·7. Excellent object for small telescopes. The brightest pair to be observed in this country; can always be relied upon as a good show object.

κ Geminorum, separation 6″·3, mags. 4, 8·5; very pretty double.

ξ Cancri, separation 1″·1, 5″·3, mags. 5·0, 5·7, 5·5; with small telescopes the wider component is readily seen.

ν Draconis, separation 61″·7, mags. 4·6, 4·6; a pretty and easy double, can be separated by observing with a pair of opera glasses.

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SUPPLEMENT.

London's Transformation.

A Suggestive Sketch of Days to Come.

(*Continued from page* 342.)

By TEMS DYVIRTA.

[Cornelius Tush was a great American financier, whose modes of business were perhaps not always quite above suspicion. He had hit upon the great idea of diverting the course of the Thames so as to cause the river to flow away to the country, and leave its dry bed in London available for building sites. He had made business arrangements with a number of people, had formed a large Company to make the deviation, and finally the work was completed. Tush, however, was sorely disappointed with the treatment he had received in England, where many people looked askance at his methods, and had returned to America.]

CHAPTER XI.

AMERICA.

The United States were simmering, presently they would boil, but just now there were only indications of the coming excitement. For the time had arrived for the President to make his bow and hand over his grave responsibilities to another caretaker. A rich man can soon make himself popular, at all events, with the mob. A discreet man can always make himself looked up to; if he knows how. At this moment, too, the American people were suffering from one of their periodical attacks of Anglophobia. It is difficult to say exactly why. England had made herself objectionable in their eyes by successful negotiations which had ended in extensive annexations in the Far East. Though their Government had raised no formal objection, the citizens of the States felt they had been bested, and, nowadays, with their large and formidable fleet, which had been fostered and greatly increased during recent years, a warlike tone prevailed, which made them long for a chance of showing off their power.

Cornelius J. Tush, seeing his opportunity, soon became the man of the hour. A judicious and lavish expenditure of money, combined with his undoubted power of mind and the high repute in which he had formerly stood, soon brought him to the fore. There was another factor, too, that greatly added to his popularity. Libertia had now blossomed forth into a most beautiful and accomplished young woman, fascinating to all. She heartily entered into her father's interests, and though still young, had inherited so much sound shrewdness that she was able to be of the greatest assistance to him.

In due time the pot began to boil, and Tush was nominated as a candidate for the occupancy of the White House. Hatred of England now became the great election cry. This, of course, was thoroughly to Cornelius' heart. He hated the English intensely now that he had dug his vast fortune from under their feet. Unfortunately for him this feeling was not vehemently supported by his daughter; she had loved England. The few years she had spent there were some of her brightest (though they had such a melancholy termination), and she looked back on them with feelings of pleasure and admiration. English people had been so kind to her, and it had been of such absorbing interest to watch the great change developing in London with which she was so closely associated. She, poor girl, had known nothing then, and knew but little now of the awkward scandals associated with her father's name, and she often wondered at his speaking so bitterly of that country which had seemed to her a second home.

Not only had Tush succeeded in accumulating vast wealth in England, but some of his old speculations in the States had lately brought in considerable sums. Among them was the great ship canal which was now completed and open for traffic between the Atlantic and Pacific. This was at once recognised as a great strategical acquisition from a naval point of view. The United States influence in Mexico, too, had steadily grown, while that of England had for many years as steadily declined, and now it was actually suggested that that country should be incorporated in the States. To all this England had raised strong objections. The Hay-Pauncefort Treaty was continually quoted. The United States Government pointed out that England had, in Jamaica, a base of operations forming a dangerous obstacle to their use of the canal, that they were entitled to a similar base, and persevered in the negotiations. Relations became highly strained, and at this critical moment the presidential election took place. Everyone felt that the result of the election meant peace or war according as the republican, Mr. Sherston, or the democrat, Mr. Tush, were elected. Never before was there so much excitement over an election. Naturally the anxiety in England was almost as intense as that in the States.

In due time the election came about. Tush was returned as President by a large majority. The result was inevitable. New York was in a ferment, and every right-down Yankee clamoured for war. England was sullen and depressed. An ultimatum was sent, an unfavourable reply returned, and the sword was drawn.

"How sharper than a serpent's tooth it is to have a thankless child!" So might Britannia well have wailed. For a feeble old man to see his stalwart son in all his strength is a pleasure, but it is very humiliating if it comes to blows and the might of the offspring supervenes.

These were the sentiments of the British public when they heard the news that the entire fleet of the United States had set upon the few vessels we had in West Indian waters and beaten them completely. Pressing through the Ship Canal the American vessels had then gone in pursuit of our Pacific Squadron. The result could clearly be foreseen. Our ships were mostly scattered about and a long way from ports of refuge. To reinforce them would imply the withdrawal of our ships from nearer home. Australia, however, was threatened, and help must be sent. Finally it was decided to send off the whole of the Mediterranean Fleet to the East.

No sooner was the magnificent Fleet well away in the Indian Ocean than news arrived, scarcely unexpected, that most of our ships in the Pacific had succumbed to the superior force of the enemy. It was evident that our fleet must be pushed on with all speed, else Australia, or, at all events, her outlying islands, would be invaded.

Many anxious days passed awaiting developments. Meanwhile numbers of troops were being massed and embarked for Canada, and it was hoped that this would create a diversion necessitating the recall of the enemy's navy. It did so. One day the news arrived that their fleet had repassed through the Panama Canal and was once again in Atlantic waters. Yet most of our best vessels were on their way across the Pacific after them, and it was now ascertained that the United States, disregarding the neutrality of the territory, disdaining

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their former treaties, were erecting strong defences at the end of the Canal and were mounting such guns as would prevent our fleet from forcing its way through. And the position was in other ways very unsatisfactory. Most of our defence ships were convoying our troops to Canada, yet they would hardly be strong enough to resist the attack of the entire United States Navy. Many of the transports with their escorting men-of-war were captured in mid-Atlantic, and urgent messages had to be dispatched calling together all ships that could possibly be spared from other places to return immediately to the Channel for home defence. The Trans-Atlantic cables were cut, and direct communication with Canada ceased.

It was now evident that a very important naval engagement was about to take place, and, as practically all available ships of both sides were concentrated, it should have most decisive results, Both nationalities were confident of victory, and the movements of the two fleets, sent back by wireless telegraphy, were watched with the greatest of interest. Foreign nations, too, all stood by with bated breath as the two most powerful naval powers closed in the deadly embrace.

It was a calm, misty morning, the sea as smooth as a sheet of glass, but with a slight swell on, sufficient to cause a slow, lazy roll on the great leviathans awaiting their turn to enter the bloody arena. Suddenly the news flashed in from one of the reconnoitring destroyers that the hostile fleet was approaching. The British Fleet, responsive to the Admiral's signals, moved out to meet its foe. Scarcely had the first gun been fired from one of the advanced vessels than the *Queen Victoria*, the finest ship in our Navy, was seen to heel over as a fountain of water flew up at her side, and rapidly she turned on her beam ends and sunk. Undoubtedly she had been struck by a torpedo, but whence did that come? Very shortly after another fine vessel went down in an exactly similar manner. The day was not favourable for gunnery, for the haze was so great that ships could not be seen at any distance. The British destroyers dashed boldly forth to launch their torpedoes, but they suffered heavily, for the enemy, awaiting their onslaught, could hear the approaching destroyer before she became visible, and were ready with their numerous guns to give the little vessel a terrible salvo directly she appeared in sight. A third of the big battleships having gone to the bottom in the same mysterious way, it was soon conjectured that the cause could be assigned only to submarines. Yet how could these be employed in mid-ocean? Soon the sharp look-out detected one emerging above the surface. It was soon seen to be of vast dimensions. Machine guns were at once trained to bear upon it, but the shots only spattered on the turtle-back harmless as rain. And now for the first time did the British officers realise that the Americans possessed a huge submarine battleship of the most powerful kind with armoured decks capable of turning aside even the heaviest projectiles. Another terrific report and a fourth splendid vessel became a total wreck. There was but one course to pursue, and that was to speedily fly from this infernal leviathan, and the British ships turned homeward, pursued by the undamaged enemy.

The game was up. The mighty British fleet, which had for so long ruled the waves, was beaten. The battered remnants put in to various ports around the coast, crest-fallen and vanquished. All that could be hoped now was that our ships from the far Pacific, hurrying on their homeward journey, and now already passing Malta, would be back in time to prevent any attempt at the invasion of England. But there came the awful news that several of the enemy's big ships had been sighted off Gibraltar, and that the door of the Mediterranean was carefully guarded. No single vessel dare approach the English coast for fear of encountering the powerful hostile fleet now patrolling around. Frantic efforts were being made meanwhile to prepare to resist any attempt at invasion. Food supply was the great question. So far most of the Continental routes were still open, guarded by the remnants of our navy. Vast stores were by this means being got into the country, though purchased at fabulous prices. Every available plot of land was being ploughed up to plant wheat. Cattle, imported by the thousand, were being killed off, and the meat preserved, so that the pastures could be turned into cornfields. The great fortifications already constructed around the North Downs were being supplemented by other works. The arsenals, as well as the dockyards, were as busy as they could be. Many of our best troops were either in Canada or had been captured en route. And what with our troubles in the Far East and a small frontier war in India having called away many more, we had but few regular troops left at home. Volunteers, however, came well to the fore, and were being rapidly armed, equipped, and drilled.

And meanwhile what was doing in America? The utmost enthusiasm prevailed. On the receipt of the news of the naval victory, citizens seemed to go quite mad with delight. President Tush, on leaving the Senate, received such an ovation as has seldom before been the lot of any man to receive. He was proclaimed Victor! Hero! Saviour of his country! His popularity and success were such that he had the whole nation in the palm of his hand and could do as he liked with it.

CHAPTER XII.

THE INVASION.

One morning the good citizens of London were awakened to hear more alarming news. The American fleet had steamed up the Channel, driving before it such ships as remained to guard our shores. Following in the wake of this great squadron were a number of large transports full of troops. These, each having its appointed station, approached various points on the south coast and at once commenced to disembark its human freight. Urgent telegrams were sent hither and thither asking for troops and guns to be at once dispatched to this or that particular place. But when it became evident that there were some 12 distinct points of disembarkation, it was seen to be impossible to send to oppose each and all. To eight different districts had forces been sent, and these had arrived in time to offer good opposition to the landing; indeed, in several of these the invaders had received severe defeats and suffered heavy losses. But as more and more messages came to hand of forces landing all along the coast, it was evident that the actual invasion had commenced, and the enemy obtained a footing on our shores. When once complete units had been successfully landed in four different places, the troops from other points of attempted invasion were re-embarked and taken to these bases. The British Commander-in-Chief now decided on a plan of action. His forces being scattered and consisting mostly of untrained troops caused him to order a concentration on London, believing that to be the undoubted goal for which the enemy would make. The invaders could then knock their heads against our

fortifications, while the army was properly organised for a great counter attack. On this account did the invaders receive but little opposition on their advance towards London, and within a few days they had formed up in positions opposite our southern line of forts. Englishmen were confident that their position would remain as it was until our forces were ready to assume the offensive, when the invading army would be driven back and the harbours on the south coast, now used as their bases of supply, re-taken. It was once thought that England could be starved out in a few days, but those who held such a belief proved to be greatly mistaken. Not only were enormous supplies imported when it became evident that they would be required, but now every man, woman, and child cheerfully complied with the edict to go on quarter rations, and contented themselves with the meagre portion doled out, under official supervision, to all alike. In this way the country was able to hold out four times as long as had been anticipated.

But a surprise was again awaiting the anxious Britishers. More Yankee notions were to prove their value. Dynamite guns and machine rifles wrought terrible havoc, but the most formidable innovation was the *Subterranean Torpedo*, capable of burrowing its way through the ground like a huge mechanical mole, and, at a given moment, raising a veritable volcano. Its progress underground was slow but very sure. The hydraulic drills which protruded from its head could bore into the hardest rock at a rate of 3 inches a minute, but this implied an advance of 120 yards a day. Within a week three of the principal forts had literally been blown into the air. The triumphant army then marched unhindered on London.

It was a frightful blow to England, but the opposite feeling in the States exceeded all bounds. Yesterday it was England's great first line of defence, the sea, that had yielded to the attack, and to-day her downfall was completed by the breaking down of her land defences.

Tumultuous exultation reigned everywhere. The President's last ovation could not be exceeded. Yet *something* must be done to celebrate this great occasion. The first vanquishing of a mighty power by the new nation, the conquest of an Empire of such huge proportions. America to rule the world! England's navy vanquished would leave that of the United States far superior to that of any other nation. Canada would, of course, be annexed to the States. Wild words are spoken on such occasions, and when it was suggested, half jokingly, that this mighty nation should be formed into an Empire, and the President chosen Emperor, the cry was vigorously taken up. Tush, wherever he went, was vociferously cheered and met with cries of "Emperor," "Founder of the Empire."

Those who may have gained some idea of Tush's real nature can imagine how things struck him. The first time he heard the suggestion his mind was made up. Why should he hang back when others pushed him forward? The result was—for he took good care to strike while the iron was hot—that within forty-eight hours the proclamation was issued that, by the unanimous consent of the citizens of the United States, Cornelius Jehoshaphat Tush was proclaimed Emperor of all the territories of North America!

The people of the States were in boisterous jubilation. But they were soon to receive a sad blow. This was not the first time in history when public rejoicings have proved to be a little premature. When the news came that the invading army had not yet actually entered London, it was considered merely a politic delay, and that the forts subdued and the way clear, the formal entry would very shortly take place. It now transpired, however, that one more obstacle had to be surmounted before that could happen—the New Thames. The northern bank of this great waterway was now found to form one continuous fortification. Tier over tier of rifle trenches had been constructed with loopholed steel armour facing the masonry. There thousands of rifles could belch forth their hail of bullets with practical impunity. For the American bullets and even shells struck harmlessly against these solid ramparts, except they happened on one of the very small openings through which the defenders' deadly missiles were emitted. But the actual parapets formed so small a target that very few projectiles struck them. The land torpedoes could be of no use here. The pneumatic guns threw their projectiles across, but they were unable to destroy the lines of narrow trenches in the far banks manned by thousands of British volunteers. After a heavy bombardment with all their guns, of many hours duration, the Americans were not able to advance in force across the water. Boats were procured, but soon sank under the tremendous rifle fire brought to bear upon them. The bridges were already destroyed, and all attempts to repair them under fire proved too costly to be continued. Attempts were made to ford the great stream in the shallow parts, but obstacles had been put in the way, making this impossible.

For two whole days the Yankees fought their hardest; hundreds of shells were sent into the far bank, but so well were the British entrenched that it was impossible to materially keep down their fire. Hundreds of the invaders were shot down in trying various methods of crossing, they being fully exposed to the British musketry fire. During the darkness of night boats full of men were pushed across, but it was found that there was a system of torpedoes laid near the far bank, and the only result was an appalling loss of life. Now for the first time did the public realise the reasons why the Government had insisted on the new river being made so wide. An endeavour was next made to outflank the position, but the far bank was found to be lined all along. Down stream the prospects of crossing over got more hopeless. Up stream the fight continued for many miles, but it soon became apparent that the passage of the big river, so well guarded, was a practical impossibility. For this dashing invasion, this raid in the enemy's country, no great store of supplies was available, and those already landed were nearly exhausted. The country through which they had marched had been cleared out of all food stuffs and supplies. For every available grain had been collected for the provisioning of the great city. About this time news filtered through that the great American submarine battleship had mysteriously disappeared, having, presumably, gone down with all hands. Now, too, the remnants of the British Navy had assembled together at the Nore and Sheerness, and received such refitting as was possible. At the same time came the news that the ships in the Mediterranean, issuing under cover of darkness, had suddenly attached and driven back the United States squadrons set to guard that approach, others having gone round the Cape and attacked them in the rear.

So the tide had indeed turned. The main portion of the American Fleet rapidly went south to endeavour to assist that part which was being worsted off the coast of Spain. The remainder had to meet the unexpected attack of the desperate squadron from the Thames. The results were everywhere fatal for the Americans.

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The British Fleet chased and soon dispersed them near the Scilly Isles, and many being damaged and having no friendly harbour at hand to put in to, had to surrender, or else to try to make the great Atlantic trip in a disabled condition, in which but few were successful.

Meanwhile the invading army, running short of supplies and finding itself deserted by its ships, had no alternative but that of surrender.

Imagine the feelings of the newly made Emperor! The intelligence of one crushing blow after another came to his ears. The first had made him perfectly sick with rage. The next came as a thunder-clap which fairly broke him down. The great strain of the last few weeks, the excitement of the elections, the whirl of events on being elected President, the arduous duties which followed, especially on the outbreak of war, had been all too much for him. But there was something more in store for him yet. It had been a matter of some surprise how small was the resistance offered by British troops to the landing in England, and the question was often asked, "Where is the main British Army?" It now transpired that the troops captured in the transports on their way to Canada, were but a very small portion of the army, which, supplemented by a huge number of Canadian troops and volunteers, was now actually advancing from Canada southwards to invade the States. And all the flower of the American army was in captivity in England.

The Pacific, cleared of the enemy's ships, was alive with vessels bearing thousands of Australians and New Zealanders bound to assist their fellow-colonists in Canada.

This last shock was too much for the passionate monarch. The Emperor, on hearing it, fell unconscious into the arms of his private secretary. He was taken to his room, and medical men were promptly summoned. The gravest symptoms were manifest. Ministers and friends were urgently sent for. The Emperor's condition became more alarming. He rallied a little. His lips moved as if he wished to make a statement. At last his eyes opened, and with an effort he whispered "Libertia!" She was kneeling at his side and holding his hand. Many of the principal ministers and friends of the great man were grouped around. "Libertia," he hoarsely whispered, "tell the people of England that they have misjudged me. Wrong I may have done—often—but not such bad things as they accuse me of. That villain, Bateson, brought it all about. Would that I had been able to exonerate myself in their eyes. Tell them this." There was a long pause as all looked steadfastly on in solemn silence. At last he gave one heavy sigh, as of relief, and expired.

CHAPTER XIII.

PEACE AND CONCORD.

A few days afterwards the following proclamation was eagerly read, not only through the United States, but throughout the British Empire, and, indeed, by all the civilised world:—

"Citizens of the United States,—I, your Empress by inheritance, crave your attention.

"War, that awful heritage of mankind, bringing death and misery to millions, is raging wildly in our midst. War, whose only good is the suppression of the wrongdoers and weaklings of this earth, to demonstrate and maintain the survival of the fittest, is now manifesting itself as a death struggle between the two mightiest nations of the globe. Between the mother and her child. Between brothers of the Anglo-Saxon race. Why should this continue? What real good can come of it? Does it not bring to both nations only sorrow and degradation?

"Then, I ask you, I beseech you, I *command* you, stop it! It lies with you, the people, whose mind must be considered even by their sovereign. Think of it each one of you. Consider it in all its aspects. Shall we gain by the suppression of our neighbours? What good would it do to each one of us personally to annex their territories, already so well ruled over, so judiciously managed?

"Is it not a sin to continue such bloodshed, to sacrifice so many lives of noble, able, and accomplished men?

"Then let us end this strife. Let us shake the hand of peace and settle down once more to carry on our commerce, to bring happiness to our homes, to foster learning and industry, to better mankind instead of butchering it.

"I am, therefore, appealing for peace to that august ruler of the nation which we all should love, our kith and kin, that nation with whom we ought to go hand in hand to lead the civilised and uncivilised nations of the world and show them an example of how peace and freedom should be maintained.

"LIBERTIA."

These soul-stirring words from the heart of the young and beautiful Empress made the greatest impression on all who read them. Both nations had suffered greatly. Both had been humiliated, and but one opinion, strongly in favour of the proposed action, prevailed. In England it was the same. An armistice was promptly proclaimed, and within a short time a reasonable settlement arrived at, and a great Treaty confirmed, binding the two nations eternally to a close alliance for amicably ruling the world.

One more scene in London and this short history is ended.

It was a glorious day in June. That huge central street of London, the pride of Englishmen, the triumph of housebuilding man, was ablaze with many-coloured bunting. Triumphal arches, flags, and banners, large mottoes of welcome, and coloured designs met the eye on every side. All this betokened a nation's heartfelt welcome to a stranger—if stranger she could be called. Millions of English, old and young, had assembled to greet her, for the Empress Libertia had responded to the call of the British voices, and now arrived in their midst, a pure type of royal womanhood, the bearer of her dead father's last message.

Not forgetful of a day, many years ago, when that lovely young form had knelt to Royalty, the Hope of England's future, the Prince whose destiny was mingled with that of the people, now looked upon this prepossessing maiden. Their hearts' strings were struck with a synchronous chord, and soon the nation learned with joy that in her he had sought and found his bride. The union of the Empress of America with the heir to the British throne cemented even closer the unity, peace, and concord, so happily inaugurated between the two mighty nations.